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TECHNOLOGICAL EDUCATION AND INDUSTRIAL DEVELOPMENT*

THE financial year 1945-46 has been marked by a remarkable progress in the planning of technological education and in implementing some of the plans. Almost all the provincial governments have published their post-war reconstruction and development schemes, and some of them have published the reports of their technical and industrial education committees. These envisage a large increase in the facilities for technical education of all grades and are based on the conviction that intelligent planning of vocations and of national resources both material and human is indispensable for rapid progress. I may give some relevant information from personal knowledge. In Bengal, plans have been practically approved for transforming the Sibpur and the Jadabpur Engineering Colleges beyond recognition and for improving the Calcutta Technical School into an up-to-date polytechnic. In Madras, the University has already opened centres of advanced training in Communication Engineering, Chemical Engineering and Leather Technology; and considerable progress has been made in starting new centres of technical education at Coimbatore, Vizagapatam, Bezwada, Calicut and Annamalai University. In the Bombay Presidency, the Engineering College at Poona and the Victoria Jubilee Technical Institute are rapidly implementing their well-considered schemes of development, and the University Department of Technology in its spacious new abode at Matunga, has, with the support of private benefactions, added to its well-established courses of Textile Chemistry and Chemical Engineering, the following new courses—technology of intermediates and dyes, pharmaceuticals and fine chemicals, foods and drugs, plastics, paints and varnishes and oils, fats and soaps. Mysore is building a magnificent occupational institute at a capital cost of twenty lakhs of rupees, a silk institute at a cost of seventeen lakhs of rupees, and is reorganising its textile institute at a capital cost of seven lakhs of rupees. The Central Provinces intend to establish "a national grid of technical education which will carry a constant flow of power into industry and commerce", and have planned the establishment for four polytechnics at Nagpur, Jubbalpore, Amraoti and Raipur and are enlarging the existing College of Science into a College of Science and Technology. The Behar schemes of technological education have been conceived on a more modest scale, specially in view of the possibility that her mineral resources may make her the hub of the industrial life of India. I believe other provinces and States are also busy planning similar developments. Nor have the Government of India at the centre been lagging behind. The Delhi Polytechnic is being

* Extracts from the Presidential Address delivered by Sir J. C. Ghosh, D.Sc., F.N.I., at the Annual General Meeting of the Association of Principals of Technical Institutions (India), March 1946.

expanded and equipped on up-to-date lines at a capital cost of twenty-three lakhs of rupees. Funds have been provided for opening in the Indian Institute of Science, Bangalore, departments of Aeronautical Engineering, Internal Combustion Engineering, Metallurgy, High Voltage Engineering and Chemical Engineering, and the services of three experts from England have been secured for the first three departments. A scheme for opening in the Indian Institute, a department of Power Engineering is also under consideration.

The Government of India, however, are not satisfied that these provisions are enough. There are no two opinions now regarding the urgency of India's industrial development. The Defence Services are convinced that they can only be effective in co-operation with modern industries producing inexhaustible supplies at their rear. And even a much maligned Tory Secretary of State did not hesitate to declare in 1943-44 that "India has in her all the latent resources of raw materials, of power and of human skill to make her a great industrial country. The development of her own industries to the fullest possible extent, both for their own sake and in order to raise the standard of living of her population, is the natural and proper ambition of all patriotic Indians. I can say that the Government of this country (Britain) naturally want to see Indian industry developing to the fullest. The last thing industrialists in this country have in mind now is the idea that British export trade can best prosper by India being held back in the course of her industrial development". Effective industrial development is not possible without adequate number of trained industrial personnel. As a matter of fact, Government are convinced that finance will not be so much of a bottle-neck in post-war development as dearth of qualified technical personnel. The Indian Scientific Delegation which visited U.S.A. in the winter of 1944-45 were struck by the immense scale on which technological education and research had been fostered in that country. Following a discussion in the Board of Scientific and Industrial Research, the Hon'ble Sir Ardeshir Dalal felt that the time was now ripe for establishing in India a technological institute of the very highest grade comparable with the Massachusetts Institute of Technology. The Deparment of Education had already come to a similar conclusion; and accordingly a committee, representative of all interests concerned namely, business, applied science, technology, etc., met in April last and generally agreed that the "existing facilities were entirely inadequate both in quality and quantity to satisfy India's post-war needs." They expressed the opinion that in view of the size of India and location of her industries, the provision of four Higher Technological Institutes—one in the North, one in the East, one in the West and one in the South—would be necessary. They have suggested that one institute in Calcutta should be taken in hand immediately, and another in Bombay either concurrently or as soon after as possible. Preliminary estimates indicate that each institution of this type will require a capital expenditure of the order of 3 crores of rupees and a recurring expenditure of 67 lakhs of rupees. Considering the importance of the problem and its significance in our industrial structure, such expenditure is very much worth incurring.

Even if, as we hope, adequate funds are available, success of technological education of every type will depend on three factors—(1) recruitment of proper staff, (2) recruitment of proper students and (3) planned dovetailing of education with gainful employment. These are constant sources of headache to me—probably to all of us.

It often happens that the type of men we wish to have in our staff will refuse to respond to an advertisement, but can be had only after delicate personal negotiations. The public are on the other hand suspicious—and justly so, with so much nepotism evident in wartime—and demand that every appointment should be made in accordance with the rigid methods prescribed by the Public Service Commissions. I doubt if Sir Asutosh Mookerjee could have gathered round him such a galaxy of talent when he established the post-graduate departments of the Calcutta University by following such methods. I wish we could, in course of our deliberations, suggest a method of recruitment which will combine the flexibility of private negotiation with the scrupulousness of public service procedure.

It will also be unwise to ignore the existence of an unfortunate feeling in the country that foreigners should not be employed in important positions in the educational world. This is a short-sighted view which originated in those days—not long ago—when many third-rate British educators were appointed members of the Indian Education Service and automatically became senior to the best indigenous scholars, who had taken to education as a profession. One need not apprehend that such things will again happen in future. In our recent tour in the U.S.A., which is the most advanced country in the world in the field of technical education, we found that many European Professors of established reputation have been employed by the authorities, in the educational institutions and even in research projects of war-importance. To-day Russia is reported to be "kidnapping" the German scientists from her zone of occupation to serve Soviet technical institutions and industrial enterprises. India should not hesitate to invite experts of high standing from every part of the world, if necessary, for affording equal opportunity to Indians of all classes to acquire the highest technical knowledge and skill in their own country. It pays better to engage a foreign expert on £2,000 a year to train a dozen talented young Indians in the country itself than to send the same dozen overseas for similar training at a total cost of £6,000 per year.

This naurally brings me to a discussion of the problem of sending Indian students for training overseas. The wisdom of such a policy has been questioned recently. People should be assured that it is purly a *temporary* measure designed to train personnel required immediately for staffing our scientific and technical institutes and providing technical personnel for our rapidly developing industries; that Government fully recognise that public funds will be far better spent in equipping and staff-

ing first-rate technological institutes and scientific laboratories in India itself than in maintaining students abroad. Our memories of what happened in the past in this connection have not been altogether happy. Mediocre youngmen from well-to-do families have often gone abroad and on their return, with a degree from a foreign university, have been placed in responsible positions over the head of far more brilliant youngmen who have been trained in Indian educational institutions. Our appointing authorities have invariably ignored the fundamental truth that talent is a part of one's heritage and that education can only bring out latent talent but cannot, as the Bengali saying goes, make a horse out of an ass. A young man with an indifferent record of work in the educational institutions of our country must never, by virtue of some foreign degrees which he has acquired later by utilising his privileged economic position, be allowed to supersede the claims of those who were his betters in India, for responsible appointments. A clear enunciation of this principle will go a long way to remove the job-hunting psychology of young Indians going overseas. They will then try harder to master a subject or a technique than to get a mere degree during their sojourn abroad.

Selections for admission to all grades of technical institutions should be made purely on merit subject to the condition "that some proportion of the seats should be reserved for the educationally backward classes so that in due course the general level of education throughout may be raised". In the case of institutions maintained by central funds the student population should, as far as possible, be representative of all parts of India. I lay great stress on the provision of merit-*cum*-poverty scholarships. The worth of a State is the collective worth of the individuals constituting the State. Science is definite that ability is very widely distributed in the community, and that it would be of the greatest advantage to the country as a whole if opportunities for satisfactory training and scope for the play of such ability are most widely spread. The aim should be that every child regardless of religion, caste or income of parents be educated to the limit of his abilities. As a practical approach to that aim, our educational policy should ensure that poverty becomes no bar to talented boys rising to the topmost position to which they are entitled by virtue of their ability and character. This is the least that we should do in India to restore social justice. The provision of 400 merit scholarships and 400 poverty scholarships for a student population of 3,000 in the Higher Technological Institute is, therefore, very welcome.

We now come to the crux of our problem—integration of vocational education with gainful employment. The following observation of "Eavesdropper" in a recent issue of *Indian Finance* is worth quoting:—

"For centuries, education meant only the acquisition of the habits and mental outlook and equipment of a scholar. It did not include the capacity to make a living by giving the rest of society some consideration for letting you share in the total stock of food and clothing and other requisites of life. Indeed, work and the capacity to work were looked down upon by more than one race in history. Science languished for centuries because of man's contempt for manual work; and in India, science was virtually killed by confining manual work to the lowest class of Hindu society. The upper classes all the world over looked down on work; and the slump in self-esteem, which a consciousness of parasitism might cause, was sought to be prevented by the emphasis on the development of the mind, of culture and the like. Where culture was accompanied by pretensions to otherwordliness, the danger of education being purely lettered was even greater. Talks of true dignity of work were largely a fashionable bourgeois fetish, till the higher classes had to engage in manual work, if not for its own sake, at least as a necessary basis of technical and scientific knowledge. When the educational system supported by the State had to cater to the needs of children of the lower middle and the working classes, work and skill in work came to be included within educational aims and purposes. Training took a high place by the side of learning. The practical and social purposes of education began to be taken notice of as much as the ideal and the individual. The commonest error is to suppose that employment depends upon the content of education or the nature of the training, and not the demand for either. The error was not brought home till it was found that men with technical training had no better prospects of employment than men with a purely liberal education. The success of the educational system, from the standpoint of employment for its products, depends upon an economic organisation capable of absorbing the young men as they finish their courses of study and step out of their colleges. The student of to-day is the worker, even more than the citizen, of tomorrow. His place in office or factory must be ready there for him, earmarked well in advance of the completion of his studies. But the school or college will train him all the better for knowledge of the place he is to fulfil.

"The strong point of economic planning is that it brings production and employment together in the closest possible relation. It guards against a divergence between production and consumption by security of employment, and through it, steadiness of demand. And it ensures employment, not only by having an adequate programme of production, but also by ensuring employability. The primary function of an educational system which is designed as part of an educational system which is designed as part of an economic plan is to ensure the employability of its products at all levels and of all grades. The educational facilities will be determined by the proportion in which qualified men of various grades of attainment will be required in the different professions and crafts. It will ensure that the students entering the various departments do not exceed or fall short of the requisite number. It will be capable of speeding up or varying or intensifying the training of the students in each grade, when the progress of the plan requires such action to be taken. In other

words, education will be the handmaid of economic planning."

The sudden termination of hostilities in the East has made difficult transition of war-time industries to peace-time conditions. It has been estimated that 8 million persons in India are in the process of becoming unemployed due to cessation of war activities—about 7 millions engaged in small-scale and cottage industries for the production of goods required by the defence forces, ½ million in large-scale industries, ½ million engaged in transport, trade and office-establishments, and 1 million by demobilisation from fighting forces. 250,000 men in the last category, whose claims for re-employment should be given the highest priority desire to be absorbed in technical jobs. I do not know if any short-term plan has been prepared by Government to ameliorate this situation. My personal experience has been rather unfortunate. I know many employees in the Hindusthan Aircraft at Bangalore. Out of the 12,000 technical men there, about 10,000 have been discharged already. Under the stress of the war, we opened in the Indian Institute of Science, a department of Aeronautical Engineering equipped with a large wind tunnel and were admitting 12 graduates in mechanical engineering of Indian Universities for a sixteen month's course of intense training in Aeronautical Engineering. As long as the war lasted these men were immediately absorbed in Aircraft establishments and we were even encouraged by such appreciative remarks:—"From what I have seen I can assure you that your ex-students are a credit to the Institute. I hope they will eventually form a sound nucleus on which to build up the aeronautical engineering industry in India. This industry must sooner or later become of primary importance". Most of them have now been thrown out of their jobs and we do not know what the present trainees are going to do. The trouble is that war being now over, the Bureaucracy may again forget that time is the most valuable asset in the life of a nation as of an individual, and they may again take upon themselves the duty that we make no mistakes, and make no wrong moves, with the result that the pious wishes of a Viceroy or a Finance Member may not get a chance to be translated into actual deeds. A practical idealist is he who, while aiming at the very best, is often satisfied, for the time being, with the second or third best; a short-term plan of post-war development covering all sectors of national life, quickly evolved and capable of immediate execution, is the need of the hour. We hope such a plan would be forthcoming soon.

VEGETABLE GHEE*

SPECIAL significance attaches to the Joint Discussion on "Vegetable Ghee", held during the Science Congress Week, in view of the increasing number of vegetable ghee factories which the Central Government are encouraging to be brought into being. The problem of the nutritional value of vegetable ghee was discussed in all its bearings and it was felt that the widespread and unrestricted employment of vegetable ghee in the Indian dietary, in absence of an authoritative and trustworthy pronouncement if its nutritional value or at least its innocuousness, was fraught with danger to national health. As Professor Damodaran of Madras pointed out, it is curious that in spite of the growth and prosperity of the industry, there was little information regarding its nutritive value. Powerful vested interests have no doubt conspired to ignore certain facts about vegetable ghee since they would adversely affect their industry.

It is fortunate, however, that a few scientists in this country have interested themselves in the problem of determining the nutritional value of this product. Dr. V. N. Patwardhan (Bombay) who spoke at the symposium revealed that vegetable ghee adversely affected growth and reproductive function of animals. His researches have demonstrated that litters bred of rats maintained on vegetable ghee as the only source of fat, suffer from infantile mortality and the few survivors do not grow well. Dr. Patwardhan said that of the fats he investigated butter stood out as the fat *par excellence* viewed from any angle—growth, maintenance, reproduction and lactation. No particular nutritional advantage was derived by hydrogenation of a vegetable oil since the untreated oil was equally nutritive. On the other hand, information available from other sources indicated that the ill-effects of hydrogenated oils may manifest themselves in the second or third generation of animals brought up and bred on diets containing hydrogenated fats.

The refining and the hydrogenation of oils, the two essential processes involved in the production of vegetable ghee, are probably responsible for "devitalising" the oil and for depriving it of all the essential vitamins, unsaturated fatty acids and other growth-factors. Insect feeding experiments, conducted by Miss de Souza in the Section of Fermentation Technology, Indian Institute of Science, support this fact.

From the nutritional standpoint, the refined and hydrogenated "vegetable ghee" whose popularity is reaching dangerous proportions, is not only inferior to ghee made from butter but possibly harmful to the consumer. The verdict of the scientists who participated in the discussion was clear and unambiguous—consume butter if you can afford, otherwise take any of the ordinary edible oils, without any treatment, as the next best. It is interesting to recall that as early as 1930, during the symposium on the same subject held in Bangalore, Mr. P. Ramaswami Ayyar, of the Indian Institute of Science, put forward the same view. He suggested a blending of the vegetable oils followed by a suitable treatment so as to invest the mixture with the flavour of natural ghee. It is regrettable that this rationalised suggestion has not been adopted.

The Government and their departments of health will have to make these facts widely known in the larger interests of public health.

* A critical summary of the proceedings of a symposium on the subject held during the Science Congress Week at Bangalore, 1946.

SUNSPOTS

DR. A. L. NARAYAN

(Director, Solar Physics Laboratory, Kodaikanal)

SUNSPOTS have been known since the third century of the Christian Era. Oriental records contain observations of 45 sunspots made between A.D. 301 and 1205. But in the western world, soon after the invention of the telescope, the discovery of sunspots appears to have been made in the year 1610 independently by Galileo, Fabricus and Schneir-Fabricius being the first to publish the fact. Scheiner at first maintained that the dark spots were due to the transit of small planets across the sun's disc, but Galileo and Fabricius from the very outset of their observations correctly recognised that they are objects on the sun. The thought of blemishes on the sun was, however, repugnant to medieval society dominated by theological philosophy and it was a long time before the existence of sunspots was grudgingly accepted as a scientific fact. From then onwards observations of sunspots have been fairly continuous, but really systematic observations, visual as well as photographic, have been made only during the last sixty years or so leading to many important discoveries concerning the nature of these objects.

Sunspots can be observed through a very small telescope of even an ordinary field or opera glass. The safest way to observe them is to point the instrument at the sun and focus the eye-piece until a sharp image of the solar

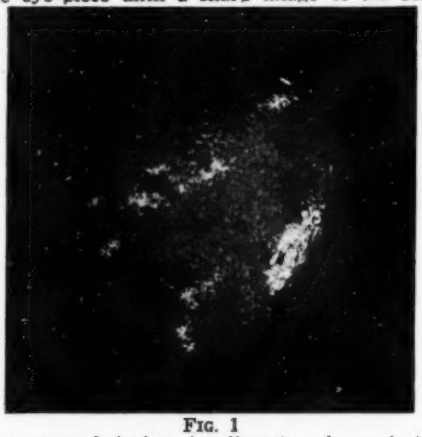

FIG. 1

disc, several inches in diameter, is projected on a white cardboard. A careful examination of this projected disc reveals that the sun has a mottled appearance, particularly near the edges. Now and then, on the mottled background dark spots appear, occasicnally several times larger than the earth. They often occur in groups and many groups of sunspots have been observed covering areas of one hundred thousand square miles or more. Recently, a large group of spots, about twenty times the size of the earth in area, was observed between 30th January and 12th February 1946 (Fig. 1). Spot areas are usually measured in millionths of the sun's visible hemisphere. If the area of a spot is more than 1000 units or about 25,000 miles in diameter, it can be seen by the naked eye when the brightness of general sunlight is reduced by the use of a shade-glass, or by thin clouds, or by nearness to the horizon. Evidently, the ancient Oriental records of sunspots refer to those observed with the naked eye and, therefore, contain no details of their structure. Modern telescopic observations, particularly those made by exceptionally skilful observers like Langley, Nasmyth, Secchi and a few others, have revealed a wealth of detail in the structure of sunspot which has gone a long way towards elucidating their real nature.

Although the structure of a solar spot varies very considerably during the period of its growth, a well-formed sunspot consists of two characteristic portions—a central, more or less circular and very dark region called the *umbra* and a surrounding fringe called the *penumbra* which is less dark and consists largely of filaments directed radially inwards. As Young has said the general appearance of a mature sunspot is "as if the umbra were a hole and the penumbral filaments overhung and partly shaded it from our view, like bushes at the mouth of a cavern". Fig. 2, which is a copy

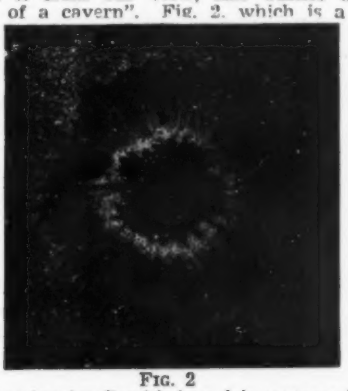

FIG. 2

of a drawing by Secchi, is a fair representation of such a spot under ordinary conditions of seeing. It will be noticed that the form of the spot in the drawing is nearly circular which is the ordinary form of a middle-aged sunspot, but during periods of formation and of dissolution a spot usually has a much more irregular shape. It will be seen also that there is no gradual shading off, either between the umbra and the penumbra or between the penumbra and the surrounding photosphere; in fact, the penumbra is clearly separated from the umbra by a bright ring and on the photospheric side it has a strongly marked dark boundary. These and many other details visible through a good telescope under good circumstances of seeing make the observation of

sunspots one of the most fascinating experiences of astronomers.

If we watch a sunspot for some time we see it move steadily from east to west in a circle parallel to the sun's equator until it disappears at the western limb and if it is a long-lived one we see it reappear at the eastern limb after about a fortnight and sensibly at the same parallel of solar latitude. This movement is, however, only apparent because in reality the spot has very little proper motion of its own and is carried along by the east to west rotation of the sun about its polar axis. This apparent east to west movement of the solar spots is so regular and so largely independent of their individual characteristics that it affords a very convenient and fairly reliable method of measuring the period of rotation of the sun. Since spots are found to occur at all solar latitudes from 5° to 45° north and south of the solar equator it has been possible by this method to determine the periods of rotation of the sun at latitudes between 5° and 45° and it has been found that the sun's rotation is quite unlike the rotation of a solid body, for example the earth or the moon; for, the sun's rotation period is about 25 days near the equator increasing steadily at higher latitudes to about 27½ days at 45°. This curious feature of solar rotation has been verified also by several other methods of measurement which have also shown that the period of rotation continues to increase steadily right up to the poles where it is about 30 days. Of course, a spot in order to be suitable for the measurement of solar rotation must be visible for a fairly long time and the longer the life of a spot the more usable it must be for the unrpose. The life of a sunspot varies from a few hours to many months, the longest duration so far recorded being 18 months. The average life of a spot may, however, be taken as two or three months. We have said above that a spot has very little proper motion; this statement is, however, true only for a spot in its middle life, for a spot in the early stages of its life as well as when it is nearing dissolution shows very considerable proper motions. It must be mentioned also that when a large spot breaks up into two or more parts, as often happens, the parts fly asunder with velocities of the order of hundreds of miles per hour. But apart from the large and irregular proper motions which actively changing spots show, even the stable sunspots have a regular proper motion which is very small, but by no means quite negligible. According to the observations of Carrington spots between 20° north and south latitudes have a slight tendency to approach the equator, the movement amounting to a minute or two of arc per day, and outside these latitudes their tendency to approach the poles is much more pronounced.

As already stated in the preceding paragraph a sunspot can appear at any latitude between 5° and 45° latitudes north and south of the colar equator, but within these belts, often called sunspots belts, the distribution of spots is quite irregular. Between latitudes 10° and 30° the frequency of spots is highest, while beyond 40° and in the neighbourhood of the equator sunspots are rarely observed. Also between the sun's northern and southern hemispheres there is often a great inequality with regard to the number of spots, although over a very long period of years this inequality practically disappears. If one observes sunspots regularly for a number of years, one is bound to be struck by the fact that the total number of sunspots observable at any time and their areas vary not only from day to day, but from month to month and from year to year. A little more careful examination of observations ranging over a long period of years shows further that this variation is not irregular. In fact as early as 1776 Horrebow had already noticed it and had expressed the view that it was periodic: But the definitive discovery of the periodicity of sunspots and the determination of the length of the period we owe to Schwabe, a German pharmacist who, in 1843, announced his results after studying sunspots with unremitting patience for eighteen years and who continued his observations almost daily until 1868. Schwabe gave about ten years as the length of the sunspot period, that is, the time that elapses between one maximum of spot activity and the next. This figure was modified by later workers who used also data prior to Schwabe's observations as well as later data. The accepted figure for the length of the sunspot period is at present 11·13 years. But a Fourier analysis of all available data has revealed at least three more periods, viz., 8·36, 4·8 and 13·5 years. Not only do the number and the areas of spots show this periodicity, but also the position and the distribution of sunspots over the sun's surface vary in a periodic manner. This was demonstrated by Spoerer who, in 1880, discovered an empirical law, sometimes called *Spoerer's Law*, according to which the mean heliographic latitude of spots from one minimum of the sunspot cycle to the next steadily decreases; this, of course, is in agreement with Carrington's observations mentioned earlier. At a sunspot minimum the solar disc may be entirely free fro mspots for weeks and even months. But broadly speaking, about two years before the occurrence of a minimum some spots begin to appear in the neighbourhood of latitudes 30° north and south; these zones of maximum spot frequency drift towards the lower latitudes and by the time they reach about latitude 16° in both hemispheres, the next maximum of the sunspot cycle occurs. The zones of maximum spot frequency continue to drift towards the equator until the spots completely disappear in the neighbourhood of latitude 3° north and south of the equator. By this time already two more zones of spot activity have appeared in the neighbourhood of latitudes 30° north and south. Thus, at a sunspot minimum there are four spot belts—two near the equator due to the expiring cycle and two more at latitudes 30° north and south belonging to the next cycle. The cause underlying these peculiarities of distribution of sunspots must be intimately connected with the origin of the spots themselves, but at present it must be regarded as one of the unsolved mysteries of solar physics in spite of many attempts at its elucidation, notably those of Bjerknes and Rosseland.

From the practical point of view, the question whether the periodicity of sunspots has any notable influence on the earth is even more important than the problem of the cause of sunspot periodicity. There are undoubtedly several kinds of terrestrial phenomena which are closely associated with sunspots and are characterised by the same periodicity as sunspots. Among such phenomena may be mentioned the auroras, the changes in the earth's magnetic field and the frequency of short-wave radio fade-outs. Various claims to the discovery of a parallelism between sunspot periodicity and the periodicity of other terrestrial phenomena have been made from time to time; some of them may eventually prove to be correct, but at the present state of our knowledge we must regard them as unestablished.

The most obvious characteristic of a sunspot is, of course, its darkness; but this darkness is not of the same type as the darkness of a piece of coal compared to a sheet of white paper. If the light from the rest of the solar disc could be completely screened off, the darkest sunspot would shine as brightly as a powerful arc lamp. It has been found by radiometric methods that the temperature of a sunspot is of the order of 4,500°, while the temperature of the background or photosphere is about 6,000 and, therefore, the darkness of a sunspot is only apparent. This is confirmed also by spectroscopic data, for the spectrum of a sunspot differs from that of the photosphere in exactly the way one would expect considering the difference in temperaturee. For example, a large number of Fraunhofer lines which are strong in the photospheric light are weakened in the spot spectrum, while a number of other lines which are weak in the spectrum of the photosphere become considerably stronger in the spectrum of sunspots. Among these characteristic differences the most outstanding ones are the following: the lines of hydrogen are weaker in the spot spectrum than in the spectrum of the photosphere ; on the other hand, the line due to the neutral calcium atom (4227 A°) is very much more intense in the spectrum of spots than in that of photosphere. These and many other similar differences between the photospheric and spot spectra indicate that the temperature of the sunspot is considerably lower than that of he photosphere. The conclusion is also supported by the appearance in spots of certain molecular band spectra, such as those of titanium oxide, calcium and magnesium hydrides, which are scarcely perceptible or even non-existent in the spectrum of the photosphere.

Apart from the information regarding the physical state of matter in sunspots, the spectrograph and its variant, the spectroheliograph, have yielded information regarding the state of motion of the material of sunspots which is quite inaccessible to the ordinary telescope visual or photographic. Fig. 3 is a photograph by Mt. Wilson Observatory of a portion of the sun's surface containing a pair of spots taken in H-alpha light with the help of a spectroheliograph. A glance at the figure shows that there are curved formations strongly suggestive of spiral motion and strikingly reminiscent of the lines of force in the neighbourhood of a pair of magnetic poles. The occurrence of such remarkable features in spectroheliograms made Hale suspect that a sunspot might be a variable magnetic pole and that it might at the same time be a gigantic whirl in which electrified particles were in a state of circular motion thereby causing a magnetic field. In 1908 Hale confirmed his suspicion by his bril-

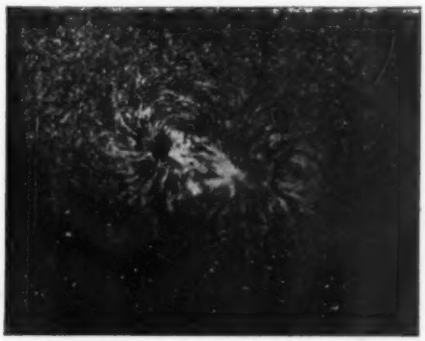

FIG. 3

liant discovery that many lines of the spot spectrum show widening and even doubling or tripling similar in every way to Zeeman-effect. He also proved that in a spot pair (which is the common type of spot formation) the two constituents have opposite polarities. The intensity of the magnetic field varies from one spot to another; in some spots fields up to 4,000 gauss have been observed. The measurement of such weak fields by means of the Zeeman-effect is naturally a very difficult process, so that our knowledge about many important questions concerning the magnetism of sunspots, such as the direction of rotation and the sign of the charge of the electrified particles supposed to be responsible for the magnetic field, is necessarily very meagre. Our knowledge of motion of matter in sunspots, however, made a great step forward when Mr. Evershed at Kodaikanal Observatory made the discovery known as the Evershed-effect which ranks as one of the outstanding contributions to solar physics. In 1909 Evershed showed that in the lower levels of sunspots there is a movement of matter in a direction radially away from their centres and parallel to the sun's surface. He also found that this movement from the umbra towards the exterior is accelerated and attains a speed of about 2 km/sec. at the outermost edges of the penumbra. Evershed's discovery was followed by the works of St. John at Mt. Wilson Observatory who confirmed Evershed's conclusions and showed besides that in the higher levels of spots the movement of matter is precisely the opposite ; i.e., matter flows towards the centre of the spots. The general picture (Fig. 4) of the motion of matter in sunspots which emerges from the researches of Evershed and St. John is that above a certain level in the

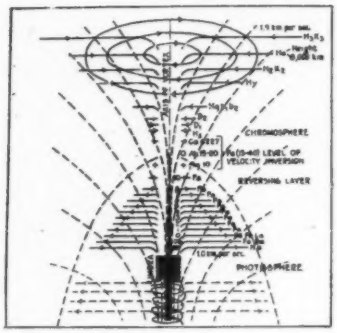

FIG. 4

interior of a sunspot (which may be called the inversion level) the motion is inwards (that is, towards the axis of the spot) and downwards, the speed increasing with height above the inversion level where the velocity is zero; while below the inversion level the motion is outwards and upwards, the speed increasing with distance below the inversion level. Thus although even in scientific literature sunspots are often likened to terrestrial cyclones on a gigantic scale, the motion of matter in a sunspot is the very opposite of what one finds in a terrestrial cyclone. Indeed the motion of matter in sunspots is very complex and although some of its details have been revealed by spectroscopic technique a great many more have yet to be discovered before one can hope to unravel the mysteries of the origin and the maintenance of these whirlpools of immense dimensions.

D.D.T., 666 AND INSECT PESTS OF STORED GRAINS

By M. MAQSUD NASIR

(Imperial Agricultural Research Institute, New Delhi)

THE axiom 'Necessity is the mother of invention' holds true, especially during the days of war when problems not seriously attended to before are solved quickly. The Entomologists too kept pace with other scientists in the second World War and were able to demonstrate the utility of substances like Dichlorodiphenyl-trichloroethane (D.D.T.) and Benzene hexachloride (666) for the control of insect pests. These substances have been known from 1874 and 1825 respectively and are highly poisonous to insects but are not so to animals and as such are undoubtedly of great value in the control of insects infesting fruits, vegetables and stored grains. The low volatility of these substances unlike naphthalene and camphor, keeps them effective for a longer period. Thus they embody one of the important properties which an ideal insecticide should possess. Another advantage which renders them the champion of all insecticides is that they act both as stomach and contact poisons and are insoluble in water. They dissolve readily in petroleum oils and do not react with strong acids, however, the alkalies do affect their composition but alkalies in traces as found in dry ashes, coal ash clinker, lime, etc., have little deleterious effect upon their efficiency at room temperature; this was ascertained from mixing experiments where different dusts were used for diluting these insecticides. They act as nerve poisons affecting the muscles and causing death by paralysis.

Benzene hexachloride is non-poisonous to human beings and animals in quantities recommended against insects. Recently Dr. Slade stated that the 'gamma' isomer of benzene hexachloride known as 'Gammexane' is about five times more toxic than D.D.T. and that 30 milligrams of 'Gammexane' per day for five weeks or 100 milligrams of the mixture of isomers for two months could be fed to rats without any untoward effect, while the actual amount of 'Gammexane' required to give 50 per cent. kill in six days in case of *Calendra oryzæ* was 0·7 parts per million of the weight of grains. Although there appears to be little or no danger to animals by the use of 666, care must be exercised in handling it. D.D.T. on the other hand is somewhat toxic to animals and hence needs special care in treating materials meant for human consumption. Prolonged smelling of the two substances causes giddiness and the brain gets fagged, but these conditions disappear in three to four days' time. The substances when handled in the form of solutions in vegetable oils without proper precautions, get absorbed through the skin and cause slight shivering of the portion of body which remains exposed for a longer period.

As regards insects, the effect was noticed to be greatly pronounced in case of adults of *Sitotroga cerealella* and *Corcyra cephalonica*. The moths soon after coming in contact with the treated grains, appear very much disturbed and excited. They struggle in vain to penetrate deep into the grains. The whole body appeared to be shivering till the insects found apparently dead were seen with their genitalia pulled out and moving in a characteristic fashion.

In coleopterous insects, the effect in its initial stages is in the form of 'paresis'. The senses are benumbed and the legs are paralysed first and rendered of little use to have firm hold on any object. The effect is more pronounced in case of *C. oryzæ* and *Bruchus affinis* where the wings also get paralysed and shortly after the stupor increases considerably. The insects behave somewhat like an intoxicated man; they stagger and fall frequently as the 'paresis' increases. The insects are incapable of feeding

as the nerves controlling their mouth-parts get paralysed. In their last moments, the activity decreases considerably and they are found apparently dead before they succumb completely with their wings remaining stretched, especially in case of *C. oryzæ* and *B. affinis* (Figs. 1 and 3).

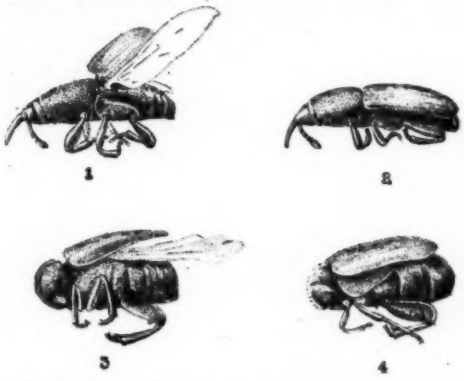

FIG. 1. Death due to D. D. T., or 666 (*Calandra oryzæ*, adult size ×9).

FIG. 2. Natural death (*Calandra oryzæ*, adult size ×9).

FIG. 3. Death due to D. D. T., or 666 (*Bruchus affinis*, adult size ×9).

FIG. 4. Natural death (*Bruchus affinis*, adult size ×9).

These observations are based on a variety of experiments performed in 1944-45 where grains were treated at the rate of 1/5,000 and 1/10,000 and the poisons diluted with chalk in a proportion of 3 to 89.[1] Complete mortalities were achieved in about three days' time in case of adults of *C. oryzæ*, *Rhizopertha dominica*, *Tribolium castaneum*, *S. cerealella*, *C. cephalonica* and *Trogoderma khapra*. It is interesting to remark that the larvæ of these insects are somewhat resistant and may require fifteen days or even more for complete mortality; grubs of khapra beetle were the most resistant and complete mortality could not be achieved even after seventeen days. They moulted and pupated normally but appeared attenuated.

Observations were also recorded in case of experiments where the insecticides were used in whitewash at the rate of 0·1, 0·2, 0·4, 0·6 per cent. and about 10 c.c. of the wash was used to cover an area of 1 sq. ft., to note their action. It was seen that only 0·6 per cent. dose could paralyse and kill *C. oryzæ* to a state of stretched wings. Lower doses also killed but had not the same type of paralysing effect. This observation was further confirmed when it was noticed that a dose of 1/5,000 as dust could not kill *T. castaneum* in the above-mentioned state, i.e., stretched winged, while very high doses could cause slight stretching of hind wings in some cases.

666 was quicker in action than D.D.T. and a larger number of insects died with stretched wings.

The observation on the stretching of wings will be useful while experimenting with these poisons and will enable one to discriminate whether the insects are dying as a result of the poisons or due to some other factors.

The author takes an opportunity to thank Dr. H. S. Pruthi, Plant Protection Adviser to the Government of India and Director, Locust Control, for his unfailing interest and guidance in the work; Dr. T. Ahmad, Second Entomologist, I/C Division of Entomology, I.A.R.I., New Delhi, for the constructive criticism; and Mr. D. Badri, who prepared the drawings.

1. Pruthi, H. S., and Nasir, M., *Indian Farming*, 1945, **6**, (2) 506-10. 2. Slade, R., *Hurter Memorial Lecture*, Liverpool, 9th March 1945 (unpublished).

A MUSEUM OF EVOLUTION

By Prof. B. SAHNI
(*Lucknow University*)

MR. M. S. RANDHAWA is well known to his friends as a practical idealist, and his suggestion for the creation of a Museum of Evolution[1] at a suitable centre in India is both apt and opportune.

We may have our own views on the origin of communalism and similar institutions in this country—and they would well repay study on evolutionary principles, even in the proposed Museum itself. But our support to the idea of organising a Museum or Museums of Evolution in India can be based upon other grounds, equally urgent.

As an instrument of popularising science, the museum method is valuable in view of its direct, though unusually silent, appeal to the inquisitive mind. Of course no public museum need, or should, be a silent instructor. As Mr. Randhawa suggests, short conducted tours through the museum, film talks and demonstrations are an important part of any such museum's functions. Provided the conductors employed are of the right calibre they can go a long way to put life into the exhibits. The conductors need not all be regular members of the museum staff: selected teachers and senior students from a local college or University may, for instance, be invited occasionally to explain sections of the museum in which they are specially interested.

It has been said that a good museum is a series of explanatory labels illustrated by a few specimens. The emphasis on the explanatory text is correct but I venture to suggest that, apart from the written and the spoken word, a careful selection of the illustrative material and its logical arrangement, is of the utmost value. In this respect I believe an ideal museum is—or was—the Deutsches Museum at Munich: I do not know if it has survived the havoc of the war.

In that museum I have spent day after day without feeling the museum-walker's fatigue. There was no overcrowding of dull exhibits,

no bewildering multiplicity of routes to follow. One-way traffic was enforced: portions in which one was not interested was simply passed by and one knew what one was leaving out. Pains were taken to arrange the material in each section historically—an excellent idea which gave a perspective view of the whole subject, so valuable to all students. A striking feature was the number of *original specimens* exhibited: for example, the historic Magdeburg hemispheres were there in the original, with a wonderful mural painting of the colourful scene when two opposing trains of horsemen failed to pull the exhausted hemispheres apart, to the amazement of a distinguished gathering of dukes and duchesses. In the chemistry section exhibits from famous old laboratories were shown, including, for instance, some of Bunsen's own burners, Liebig's condenser, and so forth. A section, devoted to the evolution of the means of locomotion, was fascinating: quaint old velocipedes were on view, as well as the latest devices for fast motion through the air, on water and on land. I remember having been approached as a possible intermediary for acquiring a real Benares *ekka* for the museum. In a room by itself was kept the balloon which at that time (1912) held the record for altitude, which I believe was only 10,000 metres. Rontgen's X-ray apparatus was also exhibited, as well as many other historic evidences of the achievements of modern science, such as the development of the wireless, and of the dye-stuff industry. What is more, one was allowed to operate a good many experiments, some of which were set up in show-cases or enclosures but could be worked by pressing a button or turning a handle; and a conductor was always handy. Lastly, some of the latest researches in each subject, specially those carried on within the country, were given a prominent place among the exhibits and demonstrations.

I cite the example of the Deutsches Museum —which in some ways was the pioneer, though now there are many other fine examples in Europe and America—in the hope that in the planning of a Museum of Evolution an attempt may be made to introduce some of these features, and the growth of our knowledge of evolution *in its widest sense* may be illustrated in the Museum with material collected from all possible sources.

To-day it may no longer be possible to secure any of the classical original material to illustrate, for example, the evolution of birds, or the history of Early Man; but with so much active research in progress, say, in genetics (to mention only one aspect of evolution) one could, by appealing to the original workers, obtain without difficulty a representative set of plants and animals illustrating their own current work.

Of fossil material there is no lack in the country, if only an organised attempt is made to collect. Field excursions can be held in co-operation with educational institutions and arrangements for exchange made with the Universities and colleges where geology is taught —of which, by the way, I hope there will be very many more—with the Geological Survey of India, and with museums abroad.

But the scope of the proposed Museum is very wide, and varied; much careful planning will be necessary, with perhaps, in the beginning, a somewhat restricted scheme of action.

Here are a few random subjects which might usefully be illustrated: The evolution of coinage; of linguistic scripts; of vestigial customs and their original significance; of boat designs; of pottery; of musical instruments; of footwear and of the modern coat-collar, neck-tie and coat-tail; of styles of hair-dress from the earliest times, through their heyday in the Gupta period, to their decadence and recent somewhat miserable attempts at rejuvenescence. All these, and many more, are little facets of the great edifice of Evolution which should find elucidation in the projected Museum. They would enrich the vision of the man-in-the-street as well as of the average student of biology whose conception of evolution is too often confined to text-book expositions of an all-pervading dynamic force.

But we must be prepared to appreciate one fact. The creation of such a museum—and we want more than one, with a re-modelling of some of our existing ones—will not alleviate some of the misfortunes to which reference is made in the opening paragraph of Mr. Randhawa's thoughtful article. Of some of these features of our life the causes lie elsewhere: but I dare not trench upon that field.

We already have a few decent museums in India. What many of our museums suffer from is not lack of exhibits but a lack of thoughtful planning, which comes from cramped space, cramped finances and, let us be frank, cramped vision in a system dominated by an unwilling and not always too intelligent directive. Have I not myself seen a fine collection of Siwalik vertebrates and other geological specimens, which must have cost great trouble and expense in collecting and naming, literally thrown into a heap on the direction of a certain old-time college Principal at Lucknow. He had the cabinets sold by auction because there was not room enough at the time for a proper museum in the college. Of the catalogue there was no trace left, and of the labels, alas, a few painted numbers remained to tell the tale of what had once been a collection of some scientific value. But this was a quarter of a century ago.

Mr. Randhawa's idea is full of promise for the future, and the benefits that result will be widespread. All who are interested in the advancement of Science and general knowledge in the country can do their part to help it forward.

1. *Curr. Sci.*, 1945, **14**, 284–85.

AGHARKAR FAREWELL COMMITTEE

THE Honorary Secretary of the Farewell Committee (Botany Department, 35, Ballygunge Circular Road, Calcutta) invites generous contributions towards the creation of a Fund for "commemorating his varied services to the cause of advancement of science in general and Botany in particular in India". Professor Agharkar's students, colleagues and admirers are requested to send in their contributions to the Secretary before 30th May 1946.

WAR AND INDIAN MINERAL INDUSTRY*

THE three most important minerals which are necessary for industry and defence of any country are coal, oil and iron. Other minerals are also necessary, but the ones mentioned above are of the highest importance. India, with the possible exception of U.S.A., is adequately endowed with large quantities of excellent iron ore, sufficient quantity of coal, bht so far as oil is concerned, the position is not very satisfactory. Regarding the other raw materials of defence, India has many of them in large quantities. She is no douot poor in some metals and ores needed in highly technical modern defence industries, but she holds a few of the most important war materials in excess which can be profitably exchanged during times of war. The most important mineral needed in times of war is coal which is absolutely necessary both for transport and industry. Large portions of Indian coal comes from Bengal and Bihar. During the last War, Indian coal trade received an impetus and as the figures indicate the production jumped from 16,460,000 to 20,722,000 million tons. But during the present war, due mainly to lack of labour, the production fell considerably and between 1939-43, it showed a steady decline.

The oil production in India is too meagre to keep up to the abnormal demands of war periods. In order to cope up with this shortage, recent work has brought to light a few deposits in Punjab which may become important producers of oil in future. The other known oil deposits of India, of the type of Digboi, etc., recorded an increased production from 81 to 101 million gallons in 1941 but again showed a fall to 96 million gallons during 1943. During the recent war, Germany made good her oil shortage by producing oil from coal, but this process may not suit Indian conditions due to limited quantity of coal available. The geologists are of opinion that even if all known sources of oil is tapped, the same may not be sufficient to meet the ever-growing needs of the country.

So far as iron is concerned, India is fortunate in containing an abundant quantity of suitable ores of iron, but lack of sufficient quantity of coking coal has been a great handicap for this most essential and basic industry needed both in times of war and peace. Though manganese is becoming of lesser importance in wars, large amounts were, however, used in the steel manufacturing centres of the world. Indian manganese industry received a setback during the war mainly due to lack of adequate facilities for transport, but during the coming post-war period of all-round reconstruction, when unlimited quantities of steel is necessary, the position of Indian manganese will be more favourable. The recent discovery of low phosphorous manganese in Raigudda in Jeypore State is of importance in view of its proximity to ports in the east coast.

Muscovite mica has been an Indian monopoly for a long time, but in recent times Brazil has become an important producer of mica. World's electrical industries use a large quantity of Indian mica. It is possible that substitutes may be discovered for mica in post-war period, but electrical machines, designed as they are at present, have to use a large amount of mica and hence Indian mica industry, provided it keeps the cost down, is assured of its place in the world.

In order to step up production of raw materials to meet the increasing needs of the war demands in the country, a separate branch termed the utilisation branch was started in the Geological Survey of India. This was responsible for distributing improved equipment for mining and transport, which helped the Indian mining industry considerably. In some cases, the raw materials were subjected to a semi-finished process before exporting.

Beryllium is found to be very useful in copper alloys and during the war, U.S.A. needed a large quantity of this material and India supplied nearly 2,000 tons at Rs. 12 per maund. As a result of increasing demand, extensive prospecting was undertaken and numerous small deposits have been discovered in Rajaputana.

Ilmenite is found in abundant quantities in the beach sands of Travancore, and is the most important raw material for titanium white. Transport difficulties have adversely affected this industry, but future prospects of this mineral in the country is good.

Burma has been the chief producer of wolfram, and during the last War of 1914-18, she produced 4,542 tons, a record output, but later the Chinese ores replaced the Tavoy and Mergui ores from the world's market. India has really very small quantities of this material and during the recent war, a few smaller deposits were opened up for immediate needs arising out of the war.

Before the present war, Wawdwin Mines were producing the major quantities of zinc, lead and silver ores. But when Burma was overrun by the Japanese, the position of zinc became very serious, and immediately attention was paid to the old workings at Zawar in Mewar State. After locating a few lodes at depths, the work was abandoned.

India is singularly poor in sulphur, which is an essential mineral both during peace and war. During the recent war, there was great demand for sulphur for the essential industries chiefly producing war materials, and due to transport difficulties, when foreign supply was entirely cut off, the Government opened the Koh-i-Sultan deposits on the Persian border, and though this involved difficulties of conveyance, etc., it came in handy for urgent needs.

There was great demand for monazite prior to 1918, but after the electric lamp came into existence, the demand for this mineral decreased considerably. It is very necessary to locate the parent rock containing this mineral to investigate the possibilities of workable deposits in India.

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* Abstract of Dr. Crookshank's Presidential Address to the Sections of Geology and Geograpy, Indian Science Congress, Bangalore, 1946.

In India, Bengal and Bihar Provinces are the most important in any scheme of post-war activities, and since they contain the most economically important deposits, coal and iron, her defence must be of utmost importance.

The coal industry must be reorganised on a firm basis and it should not be allowed to deteriorate. Mining must be mechanised if necessary and the entire industry must be in the hands of skilled workmen devoted to their calling. The Government should hold a large reserve of sulphur for future consumption during periods of war, and for all this it is important to investigate properly the mineral deposits of India and obtain correct and detailed information regarding their extent, distribution and economic importance.

M. R. SRINIVASA RAO.

SHELLAC ADHESIVES AND CEMENTS

By S. RANGANATHAN

(Lac Information Officer, Namkum, Ranchi)

THE remarkable property of shellac-strong adhesion to smooth surfaces, finds the widest industrial application in the manufacture of micanite; and sealing-waxes derive their adhesion to the paper surface from the shellac used in the compositions. The need for securing strong bonds between glass or metal surfaces which would be moderately heat-proof and perfectly waterproof in various industries has been met by effecting slight modifications through other added materials. Two typical recipes are given below:—

(1) Shellac 100 lbs., Creosote 10 lbs., Turpentine 4 lbs., Ammonia 1 lb.

The cement is generally used for glassware and scientific instruments.

(2) Shellac 7·5 lbs., Stockholm tar 5·0 lbs., Venetian red-oxide 20·75 lbs., Methylated spirit 1·0 gal.

This cement is used in munitions for filling, joining, and protection against moisture.

An adhesive prepared by dissolving 100 parts of shellac in 350 parts of water containing 15 parts of borax and 5 parts of sodium carbonate is useful for bonding paper and cardboard materials each other.

A bottle-top sealing composition consists of the following materials melted to a homogeneous mass*:—

Shellac 10 parts, Hydrolysed lac 10 parts, Castor oil 1 part.

A harder composition for topping corks is prepared as above with an additional 10 parts of mineral fillers.

An adhesive for making loudspeaker paper cones is made up of the following*:—

Shellac 10 parts, Hydrolysed lac 5 parts, Water 30 parts, Liq. ammonia 2 parts.

In a recent article entitled "Adhesives based on shellac and its derivatives"[1] Mr. N. N. Murty has made a detailed study of adhesives, cements and glues and has given several useful recipes, their mode of application and particular preferred applications, a few of which are given below:—

Cement—

Shellac 50 parts, Hydrolysed lac 25 parts, Wet ground mica dust 24 parts, Malic acid 0·6 part, Tartaric acid 0·4 part.

Melt and mix the above at 110-120° C. for 30 to 40 minutes and apply the molten mass to hot surface and press gently. The cement is useful for joining core laminations of electrical instruments, bonding wood, fibre-board, etc., to metals and paper or cardboard scales to metal backs in meters, clocks, etc.

Adhesive paste—

Hydrolysed lac 98 parts, Tartaric acid 2 parts, Water 15 parts.

Mixed warm at 40-50° C. in putty mill and after spreading over the surfaces to be bonded, the joint is baked at 150° C. for 3 to 5 hours under light pressure. The material is particularly useful for sealing cracks in metals and castings, and for effecting metal to metal bonds.

Glue—

Shellac 100 gms., Tartaric acid 2 gms., Methylated spirit 280 c.c.

A shellac varnish prepared as above is quite suitable for bonding small rotars and fixing paper to metal and glass surfaces. The adhesion strength is greatly increased by baking at 180° C. for 1 hour under clamp pressure.

The addition of fillers like finely divided mica powder and slate dust results in greater toughening of the bond and the former also increases electrical insulation characteristics.

* Based on investigations at the Indian Lac Research Institute, under publication.

1 *Plastics*, 1945, **9**, No. 103.

SIR C. V. RAMAN, F.R.S., N.L.

SIR C. V. RAMAN has been invited to accept the Honorary Professorship of Physics of the University of Travancore. He has also been requested to advise the Government of Travancore on the preparation of a scheme of research to investigate the mineral resources of the State. Travancore's mineral resources, particularly the monazite, ilmenite and other mineral sands have, in recent months, attracted worldwide attention in view of the fact that these "sands" constitute potential sources of atomic energy.

LETTERS TO THE EDITOR

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DISCONTINUITIES AND HYSTERESIS IN SORPTION IN RELATION TO THE CAVITY CONCEPT

The success of the cavity concept as a general theory of Hysteresis in sorption and other associated phenomena has been amply illustrated.[1,2] In porous adsorbents, sorption and desorption are mainly filling and emptying of capillaries. The mechanism of filling and emptying of the cavity and open pores produced by the juxtaposition of four spheres of equiradius has now been considered, and expressions have been derived for the extent of filling of the capillaries for different values of capillary radius.

Filling of the Capillaries

1st stage, formation and enlargement of liquid films between spheres.—With progressive increase in vapour pressure, the liquid film formed between two spheres enlarges and the edge becomes thicker, the thickness depending upon the relative vapour pressure according to Kelvin equation. If $2r$ is the thickness of the film at the edge, r_0 the radius of the sphere and θ the angle subtended by the meniscus of the film at the point of contact between two spheres, $r = r_0(1 - \cos\theta)$. Correcting for the curvature of the meniscus, the volume of six such films is given by

$$V_1 = 6v_a = 12\pi r_0^3 \left(\frac{1-\cos\theta}{\cos\theta}\right)^2 \times \left(1 - \frac{\pi}{2}\tan\theta - \theta\tan\theta\right).$$

As the vapour pressure increases the films enlarge, the menisci of three films meet forming a circular opening at each neck between three spheres. This circular opening contracts as the film enlarges till its diameter is equal to the thickness of the advancing meniscus, *i.e.*, when r/r_0 is 0·138.

2nd stage, formation and thickening of liquid films at the necks of cavity.—Above 0·138 for r/r_0, the circular opening at the neck of cavity is unstable and a film is formed. With increase in vapour pressure, the film thickens. The thickness is given by

$$2h = 2r_0\sqrt{\frac{1 - 2\cos 2\theta}{3}}.$$

Applying correction for the curvature of the menisci the volume of each film is given by

$$v_b = 2h\left[r_0^2\left(\sqrt{3} - \frac{\pi}{2}\right) + \frac{\pi}{6}h^2\right] + \frac{3}{\pi}\cos^{-1}\frac{h}{R}v_a - \frac{2\pi}{3}\left(\frac{1-\cos\theta}{\cos\theta}\right)^3(2r_0^3 - 3h\,r_0^2 + h^3),$$

where R is the radius of the expanding film between spheres.

Volume of four such films at the necks together with the portions of films between the spheres is given by $V_2 = 4v_b$.

3rd stage, formation, contraction and collapse of the vapour bubble in the cavity and filling of open pores.—When r/r_0 is 0·183, the four liquid menisci meet in the cavity forming a vapour bubble. With increase in vapour pressure the bubble contracts till r/r_0 is 0·187. Above this, the vapour bubble collapses and the cavity is completely filled with liquid. Filling of the open pores continues till it is complete at the maximum vapour pressure. The volume of liquid during this stage of filling is given by

$$V_3 = 2v_b + 6\left[1 - \frac{1}{2\pi}\cos^{-1}\tfrac{1}{3} - \frac{1}{\pi}\cos^{-1}\frac{h}{R}\right]v_a + v_c,$$

where v_c is the cavity volume.[1] In calculating the expressions V_2 and V_3 certain approxima-

tions have been made owing to the complicated geometrical shape of the cavity and open pore. This, however, will not alter the qualitative nature of the conclusions.

EMPTYING OF CAPILLARIES

1st stage, emptying of open pores.—On lowering the vapour pressure from the maximum, the open pores are progressively emptied till the vapour pressure corresponding to the neck of the cavity is reached, i.e., when r/r_0 is 0·138. The amount of liquid retained in this stage of emptying is given by V_2.

2nd stage, emptying of cavity and contraction of liquid films between spheres.—Below 0·138 for r/r_0, the films of liquid at the necks of cavity are unstable. So they disappear and simultaneously the cavity also is emptied. Later the films between spheres contract with decreasing vapour pressure. The volume of liquid retained is given by V_1.

From the foregoing, the volume (V) of liquid held by the capillaries for different values of capillary radius (r) at various stages of filling and emptying are obtained. The actual volume and the capillary radius corresponding to it depend upon the particle radius. The relative vapour pressure corresponding to the capillary radius is given by Kelvin equation. Calculation of the actual volume and the corresponding relative vapour pressure necessitates the assumption of an arbitrary value for particle radius. The mechanism considered above is true of any particle size. Therefore, instead of actual volume, V/V_0 is calculated for different values of r/r_0 (where V_0 is the total cavity and open pore volume and r_0 the particle radius, i.e., the maximum capillary radius). The results are indicated in Fig. 1.

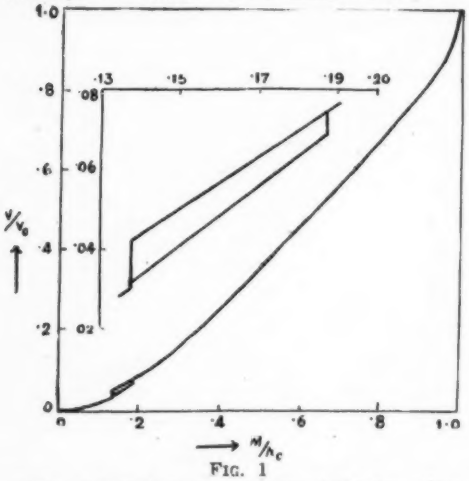

FIG. 1

The mechanism reveals the following characteristics :—

(1) The existence of the Hysteresis effect in sorption and desorption processes. The cavity produces the Hysteresis effect and its volume is very small in relation to the total capillary volume. The ratio is 0·013.

(2) Increase in the area of the Hysteresis loop with increase in cavity volume. The area of the Hysteresis loop depends upon particle radius. The cavity volume also is dependent upon particle radius.[1] The area is found to increase with increase in cavity volume.

(3) Discontinuities in sorption and desorption. During filling, the formation of liquid films at the necks of cavity, when r/r_0 is 0·138, causes a discontinuity. Later, in the filling of cavity, when r/r_0 is 0·183, there appears a bubble of the vapour which with increasing vapour pressure contracts and suddenly collapses when r/r_0 is 0·187, causing a discontinuity in sorption. Similarly during emptying when r/r_0 is 0·138, the completely filled cavity is emptied suddenly instead of progressively when the neck of the cavity is just emptied. This causes a discontinuity in desorption.

According to the cavity concept, the discontinuity should be much larger in desorption than in sorption. In the above mechanism, the discontinuity in desorption is 2·17 times greater than that in sorption.

The cavity concept affords a very interesting and convincing explanation of the vexed problem of discontinuities in sorption and desorption, first observed by Allmand and collaborators.[3,4]

Thus with cavities having constricted necks, sorption and desorption should be discontinuous as well as non-coincident. This non-coincidence, i.e., the Hysteresis effect originates as a result of the entrapping of the liquid by the cavity. If there be no entrapping there would be no Hysteresis but the discontinuity, however, can exist owing to sudden collapse and formation of vapour bubble during sorption and desorption respectively.

In a porous system in actual practice, there can be capillaries of all shapes and dimensions. It is difficult to predict on theoretical grounds the magnitude of the discontinuity and whether it is measurable with the highest experimental accuracy known. Experiment alone has to decide this point.

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Central College,
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April 2, 1946.

1. Rao, K. S., *J. Phys. Chem.*, 1941, **45**, 500–39. 2. —, *Curr. Sci.*, 1939, **8**, 468. 3. Allmand and Burrage, *Proc. Roy. Soc.*, 1931, **130A**, 610. 4. —, *J. Phys. Chem.*, 1931, **35**, 1692.

APPARENT MOLAL VOLUMES OF WEAK ELECTROLYTES

THE variation of Apparent Molal Volume (ϕ) of strong electrolytes[1] with concentration of solute (c) is governed by the interionic attraction theory equation : $\phi = \phi_0 + k\sqrt{c}$, the corresponding equation for non-electrolytes[2] being $\phi = \phi_0 + mc$, where ϕ_0, k and m are constants. The behaviour of weak electrolytes in this respect not being known, has been examined here by the author. For this purpose the data of Srinivasan and Prasad[3] on the density of solu-

tions of a number of weak electrolytes have been used.

It is found that the strong electrolyte equation $\phi = \phi_0 + k\sqrt{c}$ holds good for dilute solutions of weak electrolytes. To represent results over wider ranges of concentration, an expanded equation of the form $\phi = \phi_0 + k\sqrt{c} + mc$, in which an additional effect similar to that of non-electrolytes and obviously connected with the undissociated molecules is superimposed on the strong electrolyte character, has to be used.

The values of the constant k are in general of the same order as those for strong electrolytes of the same valence type. They also follow the order of dissociation constants.

Central Research Station,*
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Pusa, A. S. CHAKRAVARTI.
March 31, 1946.

1. Redlich and Rösenfeld, *Z. Physik. Chem.*, 1931, **155**, 65. 2. Gücker, Gage and Moser, *J. Amer. Chem. Soc.*, 1938, **60**, 2582. 3. Srinivasan and Prasad, *Trans. Faraday Soc.*, 1938, **34**, 1140. *J. Indian Chem. Soc.*, 1939, **16**, 371.

* This work was done in the Chemical Laboratory, Science College, Patna.

ON A RELATION BETWEEN REFRACTIVE INDEX AND VISCOSITY OF LIQUIDS

A COMBINATION of the Lorentz and Lorentz[1] equation for Molecular Refractive Power:

$$\frac{n^2-1}{n^2+2}\cdot\frac{M}{d} = r$$

with Newton Friend's[2] Rheochor equation:

$$\eta^{\frac{1}{8}}\cdot\frac{M}{d} = R$$

(which holds good over wide temperature ranges in case of unassociated liquids[3]) leads to the relation $\frac{n^2-1}{n^2+2} = \frac{Y}{R}\eta^{\frac{1}{8}}$ between viscosity and refractive index of unassociated liquids. Here, n is the refractive index and η the viscosity; r and R respectively denote the Molecular Refractive Power and Rheochor.

It is well known that r can be calculated from atomic and structural constants; the same characteristic is exhibited by R as well.[4] The proposed equation should, therefore, lead to the refractive index from a knowledge of viscosity at the same temperature.

The equation was found to fit in with data on a number of unassociated liquids belonging to different families within a few tenths of a per cent. in most cases.

Central Station,*
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Pusa, A. S. CHAKRAVARTI.
March 31, 1946.

1. Lorentz, *Wied Ann*, 1880, **9**, 641. 2. Newton Friend, *Nature*, 1942, **150**, 432. 3. —, and Hargreaves, *Phil. Mag.*, 1943, **34**, 643. 4. Bhagwat, Toshniwal and Moghe, *J. Ind. Chem. Soc.*, 1944, **21**, 29.

* This work was done in the Chemiccal Laboratory, Science College, Patna.

DEMETHYLATION OF 3-METHOXYFLAVONES WITH ALUMINIUM CHLORIDE

THE observation[1] that, when a polymethoxyflavone is submitted to the action of aluminium chloride under specified conditions, preferential demethylation of the 5-methoxyl takes place, has been utilised for the synthesis of several partially methylated polyhydroxyflavones and of 5:8-dihydroxyflavone. Examples are tectochrysin,[2] genkwanin,[3] primetin 8-methyl ether,[4] primetin,[5] and wogonin.[6] Hydrogen bromide in acetic acid at about 100° C. may be employed for the same purpose.[7] During the course of work on the constitution of calycopterin[7,8] it was also noticed that a 3-methoxyl, like a 5-methoxyl, is susceptible to demethylation by aluminium chloride and hydrobromic acid in acetic acid; and the preparation of 3-hydroxyflavone from 3-methoxyflavone by both the aluminium chloride and hydrobromic acid methods has been described.[7,9] Hydrogen bromide in acetic acid at room temperature was then found to attack the 5-methoxyl in preference to the 3-methoxyl. This modified procedure was suggested for the demethylation of the 5-methoxyl in calycopterin dimethyl ether (3:5:6:7:8:4'-hexamethoxyflavone),[7] leaving the 3-methoxyl intact, and the product was identified as calycopterin 4'-monomethyl ether (5-hydroxy-3:6:7:8:4'-pentamethoxyflavone).

These facts are recorded in view of extensions of earlier synthetical work in the flavone and isoflavone series which are now in progress in this laboratory. The references to the demethylation of the 3-methoxyl appear to have escaped the notice of Rao and Seshadri,[10] who mention that the use of aluminium chloride for partial demethylation was extended to the field of methylated flavonols by Krishnaswamy and Seshadri.[11]

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1. Bharadwaj and Venkataraman, *Curr. Sci.*, 1933, **2**, 50. 2. Gulati and Venkataraman, *J. Chem. Soc.*, 1936, 267. 3. Mahal and Venkataraman, *Ibid.*, 1936, 569. 4. Baker, Brown and Scott, *Ibid.*, 1939, 1922. 5. Nakazawa, *Chem. Abs.*, 1940, **34**, 1017. 6. Shah, Mehta and Wheeler, *J. Chem. Soc.*, 1938, 1555. 7. Shah, Virkar and Venkataraman, *J. Ind. Chem. Soc.*, 1942, **19**, 136. 8. Mahal and Venkataraman, *Curr. Sci.*, 1935, **4**, 311. 9. Mahal, *Ph.D. Thesis, Punjab Uni.*, 1936. 10. *Proc., Ind. Acad. Sci.*, 1945, **22A**, 383. 11. Krishnaswamy and Seshadri, *Ibid.*, 1942, **15A**, 437.

STRUCTURE OF THE EARTH'S ELECTRIC FIELD

PHENOMENA in terrestrial electricity and magnetism present a paradox which has defied all attempts to explain them on the basis of known physical laws ever since they were detected nearly half a century ago. There is, for example, the question of (1) the cosmic radiations, which have been recently increas-

ingly considered to have their origin in the outer reaches of our own atmosphere,[1] (2) source of formation, by electron collision, of positive and negative ions in the atmosphere over the earth's land surface,[2] (3) seat of separation of the massive charge in a thundercloud,[3] (4) estimate of a non-vanishing terrestrial magnetic line integral,[4] and (5) existence of the anomalous mountain effect.[5] Whereas ordinary methods of measurement indicate a normal atmospheric electric field of only one volt per cm. at the earth's surface in fair weather, and much less at higher levels, all the above phenomena point either to the existence within the normal field of a component of more than 10^4 times this value or to a rectified atmospheric electric current arising from a component electric field of this latter magnitude.

In the opinion of the author, however, it can be shown that these apparent anomalies are but a natural consequence of the most generally accepted view of the origin of the earth's magnetic field (the internal core theory), and of the existence, even at very low levels of the atmosphere at the earth's surface, of alternately positively and negatively charged ionic layers.[6]

In a previous communication to this journal[7] the author showed that a positive layer of atmosphere at the surface is at an electric potential of 10^{13} volts with respect to the earth's interior, and that of a negative layer would be consequently negligibly in comparison. Assuming the latter to be zero, it may be shown that there would be a difference of potential and, hence, an equivalent electric field across any two such successive layers of positive and negative ions, of the order of 3×10^4 volts per cm. And this, we have seen, is of just the order of magnitude necessary to produce the foregoing phenomena.

While it would be premature to build a theory with our present unfortunate lack of observational data, the indications are that there is only one principle underlying all phenomena in terrestrial electricity and magnetism, somewhat on the lines indicated above, and unless we unravel it, our ignorance of the subject, particularly of the tremendous energies latent in the phenomena, may continue to remain for a very long time to come.

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March 18, 1946.

1. Holmes, M. C., *Fr. Inst. J.*, 1937, **223**, 495, and *Phys. Rev.*, 1937, **52**, 1252. 2. Gish, O. H., "Physics of the Earth, Part VIII," 1939, p. 173. 3. Macky, W. A., *Proc. Roy. Soc. A*, 1931, **133A**, 571. 4. Schmidt, A., *Zs. f. Geof.*, 1925, **1**, 281. 5. Gish, O. H., *Trans. Amer. Geoph. U.* 1933, **14**, 40, 144. 6. —, "Physics of the Earth, Part VIII," 1939, 205, 219, 225, 227 & 228. See also ref. (1) above. 7. Arlick, A. B., *Curr. Sci.*, 1945. **1**. 231 & 1945, **14**, 318.

CHEMISTRY OF KURCHI SEEDS
PART I. ISOLATION OF A CRYSTALLINE GLYCO-ALKALOID

THE bark and seeds of kurchi (*Holarrhena antidysenterica*, N.O. *Apocynaceæ*) are reputed drugs of Hindu Materia Medica whose value has been repeatedly confirmed through clinical trials by successive Indian drug committees.[1,2] From the chemical point of view, the bark has received more attention from Indian as well as foreign investigators. The first chemical investigation of the seeds was started in these laboratories in 1926.[3,4]

A point of intriguing interest is that the crude bark juice or infusion of the seeds in milk is clinically more efficasious than any synthetic derivatives of the constituent alkaloids as evidenced by the marketing of tablets of powdered bark by Burroughs Wellcome & Co. On behalf of the chemical staff of this Institute, the possible importance of a chemical clarification of this difference of action between crude drugs in general and their isolated active principles has been discoursed at length by P. Ramaswami Ayyar in more than one Ayurvedic Conference.[5]

Though as many as sixteen different alkaloids have been prepared, mainly from the bark and to a lesser extent from the seeds by previous workers,[6] no systematic attempt has been made to ascertain the exact mode of combination of these in the crude drug. The present investigation is directly concerned with this problem.

The defatted kurchi seeds were successively extracted with a series of solvents yielding the results tabulated below.

Solvent	% of matter extracted
Ether	28·5
Absolute Alcohol	6·2
Benzene	0·6
Ethyl Acetate	1·3
95% Alcohol	12·5
Alcoholic hydrochloric acid (0·4 N)	3·3
Aqueous hydrochloric acid (3 N)	26·0
Sodium hydroxide solution (5%)	13·5

By systematic fractional crystallisation of the absolute alcoholic extract with methanol and ether, a light brown crystalline glyco-alkaloid has been separated in 1·4 per cent. yield on the weight of the seeds. The substance froths at about 65° and melts with decomposition at 200°. It is insoluble in ether, acetone and ethyl acetate, moderately soluble in methyl and ethyl alcohols and readily soluble in water. It reacts with benzoyl chloride to form a low-melting, pale yellow benzoyl derivative soluble in ether and acetone. The aqueous solution is extremely bitter, neutral to litmus, does not reduce Fehling's solution as such, gives moderate precipitates with alkaloidal reagents (Mayer's, picric acid, iodine in potassium iodide, and bromine water) and also a deep green colour with ferric chloride solution. After hydrolysis with 1:4 hydrochloric acid it gives copious precipitates with alkoloidal reagents and strongly reduces Fehling's solution.

Among the substances isolated from the

hydrolytic product are: (1) Conessine, m.p. 123-24°, melting point is unchanged on mixing with pure conessine prepared from the crystallised acid oxalate. (2) An ether-soluble viscous phenolic base giving a dense precipitate with Mayer's reagent in acid solution and a greenish brown colour with ferric chloride in alcoholic solution. (3) An ether-soluble, phenolic constituent readily reacting with benzoyl chloride to form a benzoyl derivative. (4) A sugar characterised by its reduction of Fehling's solution and the formation of an osazone, m.p. 195-97°.

Other constituents, possibly present in the hydrolytic product, as well as other properties of the glyco-alkaloid, are being studied.

I am thankful to Mr. P. Ramaswami Ayyar for suggesting this problem and giving guidance, and to Dr. P. C. Guha for kind interest.

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April 5, 1946.

1. Koman, *Report on the Investigations of Indigenous Drugs* (Madras), 1921, Appendix I. 2. Chopra, *Indigenous Drugs of India*, 326. 3. Ghanekar and Ayyar, P. R., *J. Indian Inst. Sci.*, 1927, **10A**, Pt. 2, 24-27. 4. Kanga, Ayyar and Simonsen, *J. Chem. Soc.*, 1926, 2123. 5. *Report of the 21st All-India Ayurvedic Conference and Exhibition*, 1930, 155. 6. Henry, *The Plant Alkaloids*, 1939, edn., 617.

SPECTROPHOTOMETRIC DETERMINATIONS OF IRON AND COBALT USING ISONITROSODIMETHYLDIHYDRORESORCINOL

Isonitrosodimethyldihydroresorcinol forms a deep-red precipitate with cobalt and coloured solutions with iron, copper and nickel.[1]

Iron (ferrous and ferric) and cobalt were determined spectrophotometrically using isonitrosodimethyldihydroresorcinol. Spectrophotometric studies were made in concentrations from 0·5 to 10 p.p.m. of cobalt. In the case of cobalt 50 per cent. alcohol was used to keep the complex in solution. Spectral transmittance curves for iron, copper, nickel and cobalt were prepared. A linear relation between log of transmission and concentration was found. It is interesting to note that ferrous and ferric iron complexes have equal absorptions. The optimum conditions for measurements and the effect of diverse ions were determined. 2 p.p.m. of iron was estimated in presence of 150 p.p.m. of cobalt.

The principal advantages of using this method for the colorimetric estimations of iron (ferrous and ferric) or cobalt are its sensitivity, reproducibility and simplicity. Full details will be published shortly.

My thanks are due to Sir J. C. Ghosh for his kind interest in the work.

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March 20, 1946.

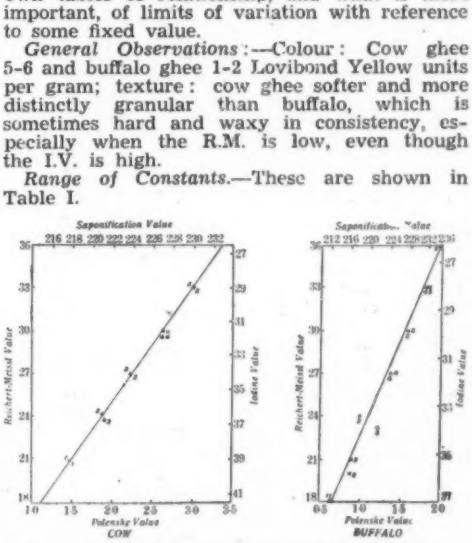
1. Guha, Sircar and Bhattacharjee, *J. Ind. Chem. Soc.*, 1941, **18**, 155-60.

THE ANALYTICAL CONSTANTS OF GHEE

While relationships between the analytical "constants" of butter-fat have been laid down in Europe, the Indian analyst in his detection of adulteration has often to go by the *individual* minima laid down in legal standards, the drawbacks of which are obvious. The relationship between the constants drawn up below after a study of 163 accredited samples of ghee from 18 tracts of India, using in addition the figures of Brahmachari[1] (50 samples of cow ghee, P.V. omitted) and Ghose[2] (233 of buffalo ghee, P.V. omitted, very narrow in range) indicated the average analytical correlations to be expected among the constants of cow and buffalo ghee. It should be of immense help to provincial analysts in the detection of sophistication. If they were to keep a record of data from accredited samples from their local ghee centres, they could draw up their own tables of relationship, and what is more important, of limits of variation with reference to some fixed value.

General Observations:—Colour: Cow ghee 5-6 and buffalo ghee 1-2 Lovibond Yellow units per gram; texture: cow ghee softer and more distinctly granular than buffalo, which is sometimes hard and waxy in consistency, especially when the R.M. is low, even though the I.V. is high.

Range of Constants.—These are shown in Table I.



Interrelation ship between the constants of Ghee,

The range for cow ghee is probably not exhaustive; the wide refractive index range is, therefore, the more remarkable.

Interrelationship between Constants.—These represent the *ideal average case* and their value is, therefore, as a yardstick against which deviations may be better judged.

A. Cow Ghee

R. M.	P. V.	I. V. (Wijs')	S. V.	B.R. at 40°C.
21	1·5	39	218	46·2
24	1·9	37	221	44·7
27	2·3	34	224	43·1
33	2·7	32	227	41·5
33	3·0	29	230	40·5

TABLE I

No. of samples	R. M.	P. V.	I. V. (Wijs')	S. V.	B. R. at 40° C.
Cow 44	16·9–28·1	0·9–3·2	31·0–45·6	212·8–232·8	42·5–47·7
Buffalo 119	14·5–39·9	0·4–5·3	21·4–39·9	198·0–239·3	40·9–46·9

The following observations arise: ((i) the R.M.-P.V. relationship is of the same order as for Western butter-fat; (ii) the I.V. are much smaller than those found in milk fats of European origin; (iii) the I.V., which is made up to the extent of about 80 per cent. by oleic acid, is inversely proportional to the R.M. value (comprising butyric and caproic acids). This tends to support the view of Hilditch and co-workers[3] that the two are related in production *in vivo*; (iv) an empirical ratio,

$$\frac{\text{S.V.}}{\text{R.M.} + \text{P.V.} + \text{I.V.}}$$

equal to 3·53, links the constants in each row of the above table.

B. Buffalo Ghee

R. M.	P. V.	I. V. (Wijs')	S. V.	B. R. at 40°C.
18	0·6	37	212	44·9
21	0·8	36	217	44·2
24	1·0	34	222	43·7
27	1·3	32	226	43·2
30	1·6	30	230	42·7
33	1·8	28	233	42·1
36	2·0	26	235	41·5

Features of interest are: (i) The P.V. are low in themselves and more so in comparison with the P.V. figures for cow ghee corresponding to the same R.M.; (ii) the mean unsaturation is less than that of Indian cow ghee (to the extent of about 3 units in each case) and much less than that of Western cow butter-fat; here are, therefore, two distinct chemical characteristics of buffalo ghee; (iii) the inverse R.M.-I.V. relationship points to the same theory of fat formation here as above[3]; (iv) the refractive index range is extremely narrow; (v) the value of the empirical ratio

$$\frac{\text{S.V.}}{\text{R.M.} + \text{P.V.} + \text{I.V.}}$$

is again constant, but equal to 3·74.

Marked effects of feeding were only noticed with cottonseed-fed animals when the R.M. fell very low in both cases, though the analytical relationship shown above was maintained. The effects appeared to be more severe on buffaloes (*cf.* Patel *et al.*[4]) .

Our thanks are due to the Imperial Council of Agricultural Research for financing these investigations, and to Prof. Subrahmanyan for his encouragement during their progress.

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January 27, 1946.

1. Brahmachari, B. B., *Indian Med. Gaz.*, 1927, **62**, 318. 2. Ghose, T. K., *Analyst*, 1920, **45**, 447. 3. Hilditch, T. P., *The Chemical Constitution of Natural Fats*, London, 1941, 238. 4. Patel, B. M., Patel, M.D., and Dave, C. N., *Indian J. Vet. Sc. Anim. Husb.*, 1944, **14**, 97.

SUPPLEMENTAL VALUE OF BRAN EXTRACT IN PENICILLIN PRODUCTION

ORGANIC and inorganic supplements have recently been shown to influence the production of penicillin. Corn steep liquor[1] increases the yield of penicillin tenfold; 0·1 per cent. Difco yeast extract[2] exerts a similar effect. Aqueous extracts of freshly ground dried peas[3] constitute a good supplement for obtaining better mold growths and increased yields of the antibiotic. A two per cent. corn oil[4] is known to give an abundant and uniform mold growth and a higher quantity of penicillin. Trace elements, notably zinc[5], are shown to augment the formation of penicillin.

An increased yield of penicillin and a reduction in the period of incubation, have both been secured by the employment of moist wheat bran.[6] More recently,[7] the inorganic ash constituents of the corn steep liquor have been shown to be partly responsible for influencing the production of penicillin.

As a part of the comprehensive programme of investigating the microbiologically active principles of the wheat bran, the effect of acid alcohol extracts of the material on penicillin production, has been investigated. Basal medium enriched with graded dosages of the extract calculated on the basis of total nitrogen, was employed and the experimental procedure and the method of assay followed during these studies, were similar to those described earlier.[8]

The basal medium was composed of: commercial glucose 40 gm.; sodium nitrate 3 gm.; potassium dihydrogen phosphate 1 gm.; mag-

TABLE I

P. notatum—N.C.T.C. 1540. Test organism: *Staphy. aureus*—N.C.T.C. 2150.

Period of Incubation in days		Without extract	with extract corresponding to			
			0,2 mg. N_2	0·4 mg. N_2	0·6 mg. N_2	0·8 mg. N_2
4	pH after fermentation	5·2	4·8	4·7	4·6	4·8
	Antibiotic activity	Nil	Nil	Nil	Nil	Nil
5	pH after fermentation	5·2	4·8	4·7	4·6	4·4
	Antibiotic activity	243 sq.mm.	396 sq. mm.	270 sq. mm.	330 sq. mm.	396 sq. mm.
6	pH after fermentation	5·4	5·0	5·1	5·2	5·1
	Antibiotic activity.	243 sq.mm.	396 sq. mm.	300 sq. mm.	363 sq. mm.	396 sq. mm.
7	pH after fermentation	5·4	5·0	5·2	6.0	5·4
	Antibiotic activity	216 sq. mm.	270 sq. mm.	270 sq. mm.	sq. mm.	243 sq. mm.

nesium sulphate 0·5 gm.; ferrous sulphate 0·01 gm.; potassium chloride 0·5 gm.; tap-water 1000 c.c.; pH 6·8.

The antibiotic activity developed after a given number of days, has been detrmined by measuring the area of clearance in square millimeters. The results are given in Table I.

The addition of bran extract was found to improve the growth of the mold, which was roughly proportional to the quantity of the supplement. It will be observed from the results that bran extract favours the formation of penicillin, the maximum being attained on the fifth and the sixth days. After this period there is a gradual fall in the antibiotic content. During these studies a sixty per cent. increase of penicillin has been obtained by the addition of the bran extract.

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1. Moyer, A. J., and Coghill, R. D., *Chem. and Engin. News*, **1944, 22,** 588. 2. Clifton, C. E., *Science*, **1943, 98,** 69. 3. Cook, R. P., Tulloch, W. J., *et al.*, *Proc. Biochem. J.*, 1945, **39,** 23. 4. Holtmann, D. F., *J. Bact.*, 1945, **49,** 313. 5. Foster, S. W., Woodraff, H. B., and McDaniel, *J. Bact.*, 1943, **46,** 425. 6. Sreenivasa Rao, S., *Nature*, 1944, **154,** 83. 7. Knight, S. G., and Frazier, W. C., *Science*, **1945, 102,** 617. 8. Ramachandra Rao, T. N., Ram Mohan, R., and Sreenivasaya, M., *J. Sci. Ind. Res.*, 1945, **4,** 377.

CYTOCHEMICAL STUDIES OF AVITAMINOSIS IN TODDY YEAST

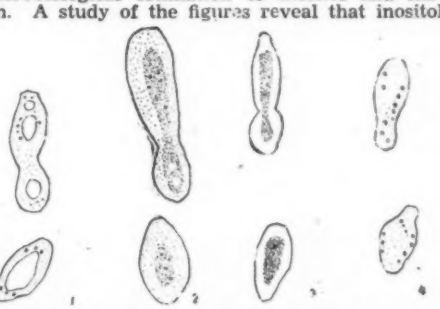
DURING studies of vitamin requirements of some yeasts, it was observed that lack of inositol modifies the gross physical structure of the yeast growth; the growth was "spongy" and granular. A microscopic examination of the cells revealed an appearance characteristically different from the cytological picture presented by the same yeast grown under similar conditions but with the full complement of vitamins including inositol.

A systematic study of the vitamin requirements of this toddy yeast (obtained from Ceylon) showed that niacin and inositol are the two vitamins which are indispensable for its growth. The organism has been grown in basal synthetic media with and without the vitamins. After 24 hours' incubation, the growth of the organisms was measured turbidometrically; cell counts also have been carried out. A microscopical examination of the cells has also been conducted (see Figs. 1-4). The results are given below:—

TABLE I

Medium	Turbidity, Absorption per-cent.	No. of cells Millions per c. c.
Basal medium + No Vitamins	9	1714
Basal medium + all Vitamins	30	13,248
Basal medium + all Vitamins except inositol	14	2184
Basal medium + all Vitamins except niacin	9	2400

It will be seen from the table that the organism offers possibilities of being used for the microbiological estimation of inositol and niacin. A study of the figures reveal that inositol



1 no vitamin; 2. all vitamins, 3. lacking inositol; 4. lacking niacin

deficiency appears to influence the formation of the cytoplasmic constituents while the lack of niacin is presumably connected with the development of the basophilic metachromatic granules and the nucleolar vacuole (?) of the cell.

T. N. RAMACHANDRA RAO.
S. P. MISTRY.
M. SREENIVASAYA.
Section of Fermentation Technology,
Indian Institute of Science,
Bangalore,
April 18, 1946.

"KAIO" AN IMPORTED BANANA VARIETY

A NEW variety of banana, 'Kaio', has been introduced in South India and it is being grown at the Banana Experimental Area of the Agricultural Research Institute, Coimbatore. This variety is a native of the Hawaiian Islands, and from the description of Pope,[1] who described it under its native environ, a true picture of its potentiality cannot be assessed. It was, therefore, thought best to observe the variety under South Indian conditions as regards its general performance and a study of this variety was undertaken by the author of this note at the College Orchards of the Agricultural Research Institute, Coimbatore, during the years 1942-1945. Only four plants were available for study and the details of performance of this variety are presented below in the form of a brief description :—

Plant.—About 10 feet in height, pseudostem about 24 inches in girth at base, tapering very little from base to crown; outer sheaths characteristically coloured light green with reddish shades, the tint extending to the petioles and the mid-ribs of the leaves; leaf-blade about 7 feet long with the greatest width being about 24 inches; petiole long, stout, margins coloured deep reddish brown and quite wide apart from each other; base of lamina unequal and the margins of the lamina coloured pink; total number of leaves produced per plant average 38. This variety is found to be a very shy sucker producing one when grown under Coimbatore conditions, the number of suckers produced varying from 1 to 4. This is a feature in contrast with the other varieties grown in South India. The plant takes about eleven months to put forth the inflorescence.

Inflorescence.—Pendant, length about 22 inches before the first bracts open; bracts light brown in colour; peduncle or stem slender, green, gracefully arched; flowers of two types, functionally staminate and pistillate ones, are met with as in the other varieties.

Bunch.—Compact with about 8 to 10 hands, each hand with about 10 to 12 fingers or fruits arranged almost at right angles to the main axis; medium bunch weighs about 35 lb. (among the plants studied the maximum weight of one bunch recorded was 50·5 lb. and it contained 102 fruits). The sterile axis of the fruiting bunch is naked, *i.e.*, the functionally staminate flowers are deciduous, and this axis ends in a small 'heart' or ovoid bud with light brown coloured bracts. The fruiting bunch takes about three months to attain full maturity from the time of flowering (Fig. 1).

Fruit.—About 6·5 inches long, 7 inches in girth at the mid-region, oblong to spindle shaped, almost straight, plumpy, 3 to 5 angled, sides inflated, angle ridges almost indistinct when fully ripened; basal end tapering into a short, stout, angular pedicel; apex very blunt and marked with a prominent scar where floral parts were formerly attached; skin medium to thin, leathery, deep lemon yellow in colour, peeling off easily from the pulp; pulp firm, slightly pinkish in colour; core distinct; taste and flavour as in 'Nendran', the Malabar Banana. This fruit may be consumed both as a fruit and as a vegetable.

FIG. 1

The present writer is not aware of the distribution of this variety in India, and he will be thankful to those who can acquaint him with their experience of this variety in localities other than Coimbatore.

In conclusion, he wishes to express his thanks to Sri K. C. Naik, Fruit Specialist, Madras, for the help and encouragement he had received from him during the course of this study.

University Botany Laboratory,
Triplicane P.O., K. S. VENKATARAMANI.

1. Pope, W. T., "Banana Culture in Hawaii," *Hawaii Agr. Expt. Sta. Bull.*, 1926, **55**.

ON THE EMBRYO-SAC OF *CLINTONIA*

IN 1911 R. W. Smith described the development of the female gametophyte of *Clintonia borealis*. According to this author, out of the four megaspore nuclei which are formed after the meiotic divisions in the megaspore mother-cell, the one situated towards the micropyle divides twice to form a four-nucleate embryo-sac; these four nuclei organise themselves as 2 synergids, 1 egg-cell and 1 polar nucleus. The chalazal three megaspore nuclei undergo prompt degeneration. It may also be noted that the megaspore nuclei are not separated by walls. This method of development is in complete agreement with the one described for *Œnothera* but for the presence of walls in the linear tetrad of megaspores. K. Schnarf (1929) has indeed classified the embryo-sac of *Clintonia borealis* as belonging to a modified form of the *Œnothera*-type. The original observations of Smith, however, have not received a whole-hearted approval from several morphologists like K. Schnarf, H. Stenar and

others; P. Maheshwari has recently (1937) tried to clarify the situation by suggesting an alternative explanation of Smith's original figures. This alternative course, according to his surmise, was most probably that of a *Fritillaria*-type, as he interpreted some of the figures of Smith as representing certain characteristic phases—"1 + 3 arrangement of megaspore nuclei" and "Secondary four-nucleate stage"—of this type of embryo-sac development.

F. H. Smith (1943) investigated the sequence of the development of the embryo-sac of *C. uniflora* and found that it corresponded with the observations of R. W. Smith for *C. borealis*. Very recently R. I. Walker (1944) has not only reinvestigated and confirmed F. H. Smith's observations for *C. uniflora* but has also studied two other species of the genus, *C. umbellulata* and *C. andrewsiana*, and has found the same type of development. These results have made it possible to note that there are no reasons to doubt the original observations of R. W. Smith on the embryo-sac of *C. borealis*. Its development reveals an unmistakable similarity to the monosporic tetranucleate embryo-sac of the type described for several members of the family Onagraceæ. As a natural consequence, the embryo-sac of *Clintonia* will have to be looked upon as belonging to the *Œnothera*-type but only with a slight modification in that the walls separating the megaspore nuclei are absent.

Basavangudi,
Bangalore, B. G. L. SWAMY.
March 20, 1946.

1. Maheshwari, P., *New. Phyt.*, 1937, **36**, 360–417. 2. Schnarf, K., *Embryologie der Angiospermen*, 1929. 3. Smith, F. H., *Bot. Gaz.*, 1943, **105**, 263–67. 4. Smith, R. W., *Ibid.*, 1911, **52**, 209–17. 5. Walker, R I., *Bull. Torrey Bot. Club.*, 1944, **71**, 529–35.

MODE OF TRANSMISSION OF THE BUNT OF RICE

BUNT [*Neovossia horrida* (Tak.) Padwick and Azmutullah Khan] of rice was, until recently, assumed to be an externally seed-borne disease. Recently Mundkur[1] has stated that the disease may be probably air-borne (floral infection), but he has adduced no experimental evidence to substantiate his assumption. Anderson[2] stated that he had found hyphæ in the stem tissues of bunted plants and Butler[3] has confirmed that finding but on what grounds these authors presumed that the mycelium was that of the bunt fungus is not very clear. In the Philippines Reyes,[4] as a result of pot and field experiments, came to the conclusion that rice bunt is systemic and transmitted through the spores adhering to the seed.

Experiments carried out by the author during the past few years have shown that this bunt is not seed-borne and that infection does not take place in the seedling stage. Examination of a large number of diseased ears has revealed that only a few grains, the number varying from two to six, are usually affected. The remaining grains are perfectly healthy. An ear in which all the grains are bunted has not so far been observed. Furthermore the bunted grains in an ear occur rather irregularly and do not conform to any ordered arrangements. The bunt is not ovaricolous but fructicolous and the grains themselves are either wholly or partially changed to a black powdery mass.

The irregular manner of occurrence of infected grains in the ear indicates that initial infection must have been external; only those grains in an ear being infected where the spores or sporidia carried by an external agency had settled down, each bunted grain representing a single, strictly local set of infection. It is manifest that the spores from the previous season lying about in the fields on the stubble or other paddy refuse or in the soil germinate in October-November with the advent of favourable conditions, producing a large number of sporidia. These sporidia, carried by the wind, settle on the ears in the anthesis or dough stage and the grains ultimately get attacked.

The above assumption was proved by experiments carried out at Sylhet during the year 1945 with successful results. Moore's[5] vacuum method of infecting the ears was used. Spores or sporidia were used for inoculation. Prior to inoculation the spores were in some cases soaked in distilled water for three to four days; the sporidia were obtained by germinating the spores in moist chambers. After inoculation the heads were covered with paper bags and labelled. Inoculations were made in October-November.

A large number of ears was inoculated. Inoculations with sporidia gave consistently better results and higher percentage of infection; in all 72 out of 97 inoculated ears showed infection. Inoculation with the spores, on the other hand, gave very poor results; only 4 out of 72 inoculated ears showed infection. It is probable that under natural conditions sporidia serve as inocula.

The author's thanks are due to Dr. B. B. Mundkur, Imperial Agricultural Research Institute, New Delhi, for helpful suggestions.

Plant Pathological Laboratory,
Sylhet, Assam, S. CHOWDHURY.
January 15, 1946.

1. Mundkur, B. B., *Indian J. Agri. Sci.*, 1945, **15**, 109. 2. Anderson, A. P., *Bot. Gaz.*, 1899, **27**, 467-72. 3. Butler, E. J., *Pusa Agri. Res. Inst. Bul.*, 1913, **34**. 4. Reyes, G. M., *Philip. J. Agric.*, 1933, **4**, 241–70. 5. Moore, M. B., *Phytopath.*, 1936, **26**, 397-400.

ON A PROTOZOAN PARASITE, *MYXOBOLUS MRIGALAE* CHAKRAVARTY, FOUND INFESTING THE FRY OF *CIRRHINA MRIGALA* (HAM.)*

IN his "Studies on Myxosporidia from the fishes of Bengal", Chakravorty§ described *Myxobolus mrigalæ* infesting the scales of adult *Cirrhina mrigala*. During an inspection of the Kalighat Fish Fry Market at Calcutta, in October 1945, evidently healthy and normal fry of *Cirrhina mrigala* of an average length of two inches were found heavily infested with this parasite. The cysts, forming small white patches, were found all over the body except the head region. The infestation was less marked nearer the caudal end and the fins

were absolutely free from cysts. Some infected fry were preserved in 4 per cent. formalin and later hanging drop preparations were made for the study of spores.

As a result of the study of the material, Chakravorty's description requires emendation on the following points:—

(1) In most cases, the polar capsules are equal while only in a few cases they were found to be unequal as described by Chakravorty.

(2) The average size of spores was found to be $8{\cdot}56\,\mu \times 8{\cdot}56\,\mu$ and of capsules $4{\cdot}28\,\mu \times 3{\cdot}21\,\mu$. These dimensions differ slightly from those given by Chakravorty but the variation is not of specific importance.

The main object in writing this note is to bring to the notice of fish culturists in Bengal the desirability of disinfecting the fry before planting them in rearing tanks. This can be done by a bath in Condy's Fluid (½ grain by weight of potassium permanganate per gallon of water) or a weak solution of common salt (0·2 per cent. solution). Besides eradicating Myxosporidian infection, this treatment will kill fungus and the Fish Louse *Argulus* which sometimes cause heavy mortality in tanks, stocked with carp.

I am grateful to Mr. Mukundamurari Chakravorty for examining the material and confirming my identification.

Directorate of Fisheries, Bengal,
13, Ballygunge Circular Road,
Calcutta, H. L. SARKAR.
February 25, 1946.

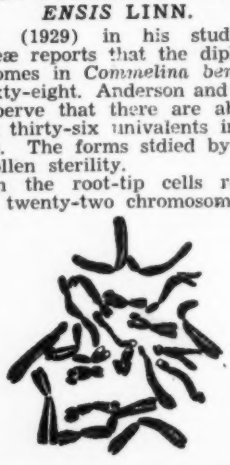
* Published with permission of the Director of Fisheries, Bengal.

† Chakravorty, M., *Archiv. fur Protistenkunde*, 1939, **92**, 173.

THE SOMATIC AND MEIOTIC CHROMOSOMES OF *COMMELINA BENGHALENSIS* LINN.

DARLINGTON (1929) in his studies on the Tradescantieæ reports that the diploid number of chromosomes in *Commelina benghalensis* is probably sixty-eight. Anderson and Sax (1936), however, oberve that there are about six bivalents and thirty-six univalents in the pollen mother-cells. The forms stdied by them show complete pollen sterility.

Studies in the root-tip cells revealed the presence of twenty-two chromosomes (Fig. 1).



Commelina benghalensis. Somatic metaphase in root tip cell showing twenty-two chromosomss (× 3000).

The chromosomes are somewhat slender and elongated. The primary constrictions are mostly median or submedian but subterminal constrictions are quite frequent. Darlington also observes that chromosomes with median constrictions are more numerous.

For the study of meiotic chromosomes flower buds of both underground and aerial branches were examined. No difference in the meiotic process was observed. Eleven bivalents are clearly seen in the diplotene, diakinesis and metaphase stages and eleven univalents can be counted in either pole at anaphase. The pollen grains appear normal and germinate well in 2 per cent. agar-sucrose solution. Furthermore, normal setting has been observed in both the underground as well as the aerial branches and the seeds show their characteristic worty nature.

Thus it appears that there is no indication of any pollen sterility in the particular form of the species studied. The writer is not aware of the sources of materials investigated by Darlington (1929) and Anderson and Sax (1936), but it appears that the form studied here is absolutely different from those of the said authors.

The writer wishes to express his thanks to Dr. I. Banerji for his interest and help.

JAYANTA KUMAR GANGULY.
Department of Botany,
Calcutta University,
February 20, 1946.

1. Anderson, E., and Sax, K., "A cytological monograph of the American species of Ttadescantia," *Bot. Gaz.*, 1936, **37**, 433–476. 2. Darlington, C. D., "Chromosome behaviour and structural hybridity in the Tradescantieæ," *Jour. Genet.*, 1929, **21**, 207–288.

A RECORD OF THE LEECH *GLOSSIPHONIA RETICULATA* KABURAKI, TOGETHER WITH A NOTE ON ITS PARENTAL CARE

SOMETIME back, while dissecting a fresh-water mussel (*Lamellidens marinalis*) in our laboratory, I came across a small leech under its mantle-cover. This leech was identified to be a species of *Glossiphonia*. The only species of *Glossiphonia* parasitic on Lamellidens, so far recorded from India is *G. reticulata* Kaburaki. Now the leech found by me is identical with Kaburaki's[1] description of *G. reticulata*, except that its colour is olive-green and in the living condition its length is 12 mm. and breadth 3·5 mm. Kaburaki mentions that there is only a single specimen of this species in the Indian Museum and this was collected by Dr. B. Prashad from Jullandar, Punjab. Harding and Moore[2] describe the species after Kaburaki's original description but mention *Anodonta* to be its host. So my specimen forms the second record of the species from India and the first from Bengal.

Its parental care was found to be most remarkable. If it had laid eggs within the mussel they might have been carried away by the food currents constantly set in motion by the mussel, and so to secure these eggs from all possible danger the leech takes the eggs in a

shallow groove formed on ventral surface by slight infolding of the lateral margins of the body, at about one-third the distance from the oral end. It carries the brood wherever it goes. The size of the groove is not constant but varies every now and then as the leech lengthens and shortens its body, but at no time does the groove disappear, and the embryos are lodged in this groove and at no other part of the body. Young ones even after hatching continue to cling to mother's fold (Fig. 1).

FIG. 1.—*Glossiphonia reticulata* Kaburaki; ventral view—showing the young leeches in the groove.

After examination of the leech under a hand lens I transferred it to a glass vial filled with tap water. At that time (December 16, 1945) I could not find any bodies sticking to the leech. After five days (December 21, 1945) when I was refilling the vial with fresh water, my attention was drawn to the ventral aspect of the leech where several minute globular eggs were adhering together with mucous secreted by the leech. I teased the leech with a needle, it moved in the typical fashion without displacing the eggs. I examined one of the eggs under the microscope. It was at an advanced stage of development which showed a slow circular motion. I gave a feed to the leech by pricking my finger and applying the leech to the cut surface. I carried on observation day to day changing the water of the vial daily. After a lapse of 20 days (January 10, 1946) I found the eggs hatched and the number of juvenile leeches noted were 37. These leeches when disturbed and forced to leave the parent swam back again to their mother's fold. What the young ones ate I cannot say. It is possible that freshly hatched ones can live without food for sometime until the proper host is seized upon. The mother which was once given a feed upon my blood was also deprived of food under captivity while kept in the vial of water, and yet remained alive.

The brood on examination on the 10th January 1946, showed fairly long young ones (measuring 2·5 mm. in length on the average) and they were leaving the parent's fold. I am now trying to infect fresh mussels with these young ones.

I should like to express my sincere thanks to Mr. Biswamoy Biswas for his kind help in connection with this work. The accompanying diagram has been drawn by Mr. U. Parui, for which I am grateful to him.

Zoological Laboratory, SIVATOSH MOOKERJEE.
University College of Science,
35, Ballygunge Circular Road,
Calcutta,
January 12, 1946.

1. Kaburaki, "Notes on some leeches in the collection of the Indian Museum," *Rec. Ind. Mus.*, 1921, **22**, 700–01. 2. Harding and Moore, *Fauna of British India—Hirudinea*, 1927, p. 65.

WHITE-FLOWERED PLANT OF *URENA LOBATA* LINN.—A NEW OBSERVATION

Urena lobata Linn. is distributed 'throughout the hotter parts of India' and in the tropics of both hemispheres[2] in general. 'In Bengal it is found as a weed of waste places and roadsides.'[3] During an excursion in April 1945, the writer came across a perfectly white-flowered plant similar in all other characters to *Urena lobata* L., growing wild among other plants beside a rivulet in the Dacca city (E. Bengal).

The flower colour of *U. lobata* L., has been described by Hooker[2] as pink, by Kirtikar and Basu[5] and by Fyson[6] as pink with darker centre. Merrill[4] in re-describing Rumphii's[1] *Lappago amboinica* as *U. lobata* L., states that the flowers are deeply purple in colour. This would suggest that flower colour of *U. lobata* L., may be either pink or purple. Reference to authorities of the Royal Botanic Gardens, Calcutta, has confirmed the identification of the plant with white flowers to be *U. lobata* L., and that a white-flowered type has not been reported before. In view of these facts it is suggested that in future description of *U. lobata* L., the flower colour should be corrected to include "white or pink", instead of pink only as at present.

Department of Agriculture,
Anderson House,
Alipore,
Calcutta, MURARI PROSAD GUHA.
August 8, 1945.

1. Rumphii, G. E., *Herbarium Amboinense*, 1750, vi, **59**, t. 25. f. 2. 2. Hooker, J. D., *The Flora of British India*, 1875, **1**, 322. 3. Prain, D., *Bengal Plants*, 1903, **1**, 261. 4. Merrill, E. D., *Interprt. Rumph. Herb. Amb.*, 1917, 354, 357. 5. Kirtikar, K. R., and Basu, B. D., *Indian Medicinal Plants*, 1918, **1**, 177, t. 125. 6. Fyson, P. F., *Fl. Nilgiri and Pulney Hill-tops*, 1928, **3**, 2, t. 222.

REVIEWS

A Food Plan for India. With a Foreword by Professor A. V. Hill. (Oxford University Press. Issued under the auspices of the Royal Institute of International Affairs), 1945. Pp. 62. Price Rs. 2.

It is somewhat strange that the authors of this well-thought-out and carefully documented book, so topical at the moment with a threatened famine on a gigantic scale, should prefer to remain anonymous. Nonetheless, the book represents a carefully prepared food plan for a concerted action, employing all the resources of science and technology and the fullest co-operation of all men of good will, to meet the needs of a rapidly expanding population for more and better food. The plan is evolved by a private group of authorities, and derives directly from Prof. Hill's compelling analysis of the situation. It is, in essence, a short-term one, covering only seven years, and as Prof. Hill has observed in the Foreword, the authors "have concentrated on working out possible machinery by which a few simple, practical measures, known from experience to be capable of giving substantial results, could be put into effect on such a scale as to increase the overall food production in India by between one-quarter and one-half in seven years". It has been considered on a quantitative basis and the financial implications thereof worked out tentatively. The plan "outlines concrete proposals by which the extra 14 million annual tons of food can be obtained, which with a 50 million increase in population and with rising standards, will be required by 1953". This target, if achieved, will ensure sufficient margin of safety. The plan is practical in every sense and affords employment to a decent number of demobilised men. The authors are certainly modest when they observe that their solution to problem is not unique, but is one, they are convinced, will work.

The authors of the plan take into account the dangers implicit in the present population and food trends in India and the fact that the accelerating increase of India's population would stultify all planning for a better way of life unless a supreme effort is economically directed to the basic problem of food production. Many measures are needed to step up food production but the authors have concentrated their attention on five important factors, viz., (1) use of fertilisers and manures, (2) improvement of water supplies and erosion control, (3) use of improved varieties of seed, (4) control of seed-borne disease and of stored-grain pests, and (5) malaria control. The present low crop yields in India come in for a good deal of attention, and measures are suggested to overcome it, in the light of experience gained in other countries. The improvement in the quality of food levels in India and distribution of foodstuffs in an efficient manner are also dealt with in a masterly way. The role of fish in Indian dietaries and development of fisheries are treated in the form of an Appendix. References to literature are done not in the conventional manner of mere citations but in a manner calculated to add greatly to the usefulness of the book. An Index is provided for.

In short, the book is an authoritative and expert document and its publication now is extremely opportune as the spectre of famine is looming large. Those interested in augmenting India's food resources—a dire need indeed—will find the book extremely useful and practical.

S. RANGANATHAN.

Famine Rationing and Food Policy in Cochin By K. G. Sivaswami; and **Medical Surveys**, By Lt.-Col. T. S. Shastry and Dr. J. A. Bhat. (Servindia Kerala Relief Centre, Royapettah, Madras), February 1946. Pp. x + 77 + 35, with 11 illustrations. Price Rs. 3.

This book by the Servindia Kerala Relief Centre stands out in refreshing contrast to its companion volumes dealing with Travancore, both in its get-up and in the presentation of the material.

The State of Cochin normally imported in pre-war times about three-fifths of her rice requirements, mainly from Burma. Its stoppage presented a really formidable problem, and the manner in which Cochin tackled the famine is admirably set forth in the book; both procurement and distribution were directly undertaken by the State and the results achieved were, in the author's opinion, far more efficient than in many parts of South India confronted with more or less a similar situation. Besides selling grains at subsidised prices, the State undertook mid-day feeding of school children, running of restaurants for supply of meals at cost price, distribution of milk to children, etc. In spite of best of efforts on the part of the authorities, the resources, till October 1944, were hardly enough to supply more than 3 or 6 ounces of rice per adult per day. The Government were then faced with the grim realisation of the fact that this quantity could not fill the stomach unless supplemented by tapioca. Protein foods, such as fish, coconut and pulses could not be had in sufficient quantities by the poorer classes to improve their rice-*cum*-tapioca diet. Ample evidence is presented of the devastating effects on the population of such an inadequate and ill-balanced diet. Deaths from severe malnutrition, dysentery and diarrhœa, anæmia, malaria, œdema, etc., showed a tremendous increase during this period of food shortage.

The food policy of the State is discussed in relation to what is urgently needed to improve the situation. The author has made useful and practical suggestions for a short-term programme which is essentially intended to prevent further deterioration in the health of the more vulnerable groups, children and nursing and expectant mothers. Measures for a long-range policy are also outlined. Special emphasis is laid on hand-pounded rice as being more

in harmony with rural economy than parboiled milled rice.

The illustrations are well reproduced and enable the reader to gain a clear insight into the appalling famine conditions. Many useful and informative appendices are to be found, including a short note on the conditions of farm tenancy in the Cochin State. One only wishes that the page-numbering of the appendices was done in a different manner; one also wishes that the expression "calcium extracts" in p.v. is substituted by a less jarring one. These are only minor blemishes in an otherwise able document.

S. RANGANATHAN.

An Introduction to the Theory and Design of Electric Wave Filters. By F. Scowen, B.Sc., A.Inst.P., with a Foreword by A. J. Gill, M.I.E.E., Fellow I.R.E. (Chapman & Hall Ltd., London, W.C. 2), 1945. Pp. 164 + 60 figs. Price 15 *sh.* net.

This excellent book is meant to help the engineer to design and construct filters by means of templates, nomographs and charts, avoiding long and laborious calculations.

It consists of 19 sections, the first two of which relate to important mathematical and electrical subjects considered essential for filter design. Sections 3 to 16 relate to design of low-pass, high-pass, band-pass and band-stop filters of the ladder type actually used in communication systems. Section 14 dealing with the various calculations by means of templates developed by British P.O. Engineering Department on the lines of Laurent and Rumpelt deserves special mention. The parallel connection of filters which is widely used in carrier telephone systems receives considerable attention in Section 15. Section 16 has been devoted to the examples of ladder type filter design and forms a very interesting reading for an engineer who intends to design his own filter.

The usefulness of the work has been considerably increased by the inclusion of Section 17 dealing with the lattice networks. The lattice type filter theory with application to crystal filters has been presented. Section 18 relates to certain practical considerations in the filter construction.

The book is highly recommended for use by the Indian Posts & Telegraphs Department, the All-India Radio and other communication administrations and concerns where the engineers have to design and construct a large number of filters for their systems.

S. P. CHAKRAVARTI.

R.S. Pay Kh.

1. **The Decimal and Colon Classifications.** (A Summary and a Comparison.) By Foreword by S. R. Ranganathan. (Poona: N. K. Publishing House), 1945. Pp. xvi + 147. Rs. 2-4-0.
2. **Classification of Marathi Literature.** By S. R. Ranganathan. (Poona: N. K. Publishing House), 1945. Pp. 44. Rs. 1-4-0.

The two books, first two accessions to the K. Taraporevala Series in Library Science, are devoted to one of the most important subjects of library classification. Any scheme of library classification is indissolubly bound up with the classification of knowledge, and as such should be not only all-embracing but *par excellence* flexible and elastic. On these premises the first book proceeds to describe and compare the Dewey, the generally accepted, and the Colon, the young and now growing, systems of classification. We cannot enter into the details of the controversy but can only refer to the soundness of the author's arguments which would hold an easy appeal to anyone who had had difficulties with the Dewey scheme in classifying his book-store. The way in which the book is written makes it perhaps the most lucid exposition yet made of the Colon classification. To libraries and especially special libraries which may have adopted their own arbitrary schemes of classification, it is an invitation to "Colonization".

The second booklet is by the father of the Colon classification. It shows the richness of the Marathi literature with its 4,000 authors, the inadequacy of the Dewey to deal with it, and the resourcefulness of the Colon language in supplying Colon numbers 'co-extensive with each author, each work of his, and each type of work on him'. This is illustrated with selected examples. When we remember that the author is not one of the Marathi-speaking public, our admiration increases all the more for his probing scholarship. The only uneasiness the reviewer occasionally felt was at the transcription of some of the Marathi phrases. On the whole, the small monograph embodies a study of the successful application of the C. C. to a special field in *belles-lettres*, and it is to be hoped that it will be the precursor of further monographs devoted to special fields in arts and sciences.

G. T. K.

An Introduction to the Taxonomy and Nomenclature of Fungi. By G. R. Bisley, M.A., Ph.D. (Imperial Mycological Institute, Kew, Surrey), 1945. Pp. viii + 117. Price 5 *sh.* or $1.25.

This slim volume is an attempt to educate and help the "Amateur" to find an easy road in his identification of Fungi. The author has chosen a non-professional mycologist and has tried to help and guide him to further the useful addition of valuable material on fungi.

The book mainly falls into two broad groups. The first is "Taxonomy" and the second the "Nomenclature of Fungi". At the very beginning, a chapter is addressed to the "Amateur", but very little information is made available except telling him to enlarge his views by attending lectures.

In the succeeding chapters under the headings Equipment, Collecting, etc., the information though adequate could easily have been made more useful by including typical life-histories of group representations at least.

The second portion of the book is entirely devoted to nomenclature whose inclusion as the author points out, is determined by the fact that "the International Rules of Botanical Nomenclature are not readily available at present."

The book is written with an eye although on the "Amateur" mycologist who does not get a salary for it. It is doubtful if with the rapid increase in the great number of technical workers in the field, and the decreasing number of such "Amateurs", the book will find increasing use. The book serves a useful but limited purpose.

T. N. R.

SCIENCE NOTES AND NEWS

Prof. P. C. Mahalanobis has been appointed a member of the Statistical Commission established by the Economic and Social Council of the United Nations Organisation. He will attend the first session of the Commission to be held at New York, beginning from April 29.

Dr. V. K. R. V. Rao, one of the Advisers to the Indian Food Delegation, has been appointed to a Special Committee of Economists by the United Nations Food and Agricultural Organisation.

The Central Government, it is learnt, is arranging to start a Central Rice Research Institute. Mr. K. Ramiah, M.B.E., formerly Geneticist-Botanist, Institute of Plant Industry, Indore, has been appointed Special Officer in this connection.

The Syndicate of the Andhra University has announced that on the recommendation of the Board of Examiners consisting of Prof. C. K. Ingold, F.R.S., Prof. G. B. B. H. Sutherland and Dr. F. G. Donnan, F.R.S., Mr. K. Venkateswarlu, M.Sc., has been declared qualified for the Degree of Doctor of Science (D.Sc.) for his thesis entitled "Intensity and Related Problems in Raman Effect".

The Senate of the Benares Hindu University, at its meeting held on the 31st March 1946, decided to confer the degree of D.Sc. in Botany (Algology) upon Mr. Rama Nagina Singh, M.Sc., on the unanimous recommendation of the Board of Examiners, consisting of Professor F. E. Fritsch, D.Sc., F.L.S., F.R.S., University Professor of Botany, University of London (Queen Mary College), and a member of the Council of the Royal Society, London, Professor W. H. Pearsall, D.Sc., F.R.S., University Professor of Botany, University of London (University College), and Professor Yajnavalkya Bharadwaja, M.Sc., Ph.D. (London), F.L.S., F.N.I., University Professor of Botany, Benares Hindu University. Mr. Singh submitted a thesis, entitled "Studies on Indian Algæ".

Kanai Lal Mendal, Professor of Chemistry, City College, Calcutta, has secured the D.Sc. degree of the Calcutta University for his researches in pure chemistry. Mr. Mandal is a first class M.Sc. and is known to the public for his popular scientific writings.

An industrial plant and machinery (heavy) Panel has been set up by the Government of India with a view to examining the possibilities of the manufacture in India of textile, sugar, paper, mining, cement, chemical and other machinery. To assist the Panel, the services of Messrs. Ford Bacon and Davis, a leading American firm of engineers, have been obtained.

The U.S. Government is planning to send a special agricultural mission to India similar to a group now operating in the Middle East. The mission will assist in mapping India's long-range programme for increasing its food supplies.

The following students of the Imperial Agricultural Research Institute, New Delhi, have been awarded the Diploma of the Institute (Assoc. I.A.R.I.) after completion in September 1945 of their two-year post-graduate course and the acceptance by the Institute Council of the thesis submitted by them :—

Agricultural Botany and Plant Breeding: Prem Shankar Parsai, B.Sc. (Agri.) (Nagpur); Malik Hukam Chand, B.Sc. (Agri.) (Punjab); Mohd. Jamil Khan, M.Sc. (Aligarh); *Agricultural Chemistry and Soil Science*: B. R. N. Iyengar, B.Sc. (Mysore), B.Sc. (Agri.) (Poona); J. K. Jagtiani, B.Sc. (Agri.) (Poona); *Mycology and Plant Pathology*: M. S. Pavgi, M.Sc. (Benares); G. C. Dacosta, B.Sc. (Agri.); K. R. Chowdhury, B.Sc. (Calcutta); *Sugarcane Breeding*: Ghulam Yazani, B.Sc. (Ag.); Jagannath Hota, B.Sc. (Ag.) (Nagpur).

In our review of the work on Pyrethrum done in the Central Research Institute, Trivandrum, appearing in the "Notes and News" section of the March issue of *Current Science*, the pyrethrin content of the flowers has been stated as 0·5 per cent., whereas it is really 1·2 per cent. A more recent report from the Secretary, Council of Research, University of Travancore, says, "an even higher content of pyrethrins (1·3 to 1·4 per cent.) has been obtained."

ERRATA

Vol. 14, No. 1, January ~~1946~~ 1945:

Page 10, column 2, para 1, lines 10-11 from top: *delete* the statement "but neither of them ..... sulphur deficiency".

Page 10, column 2, para 3, line 21 from bottom: *for* "ammonium sulphate" *read* "ammonium phosphate".

The cost of printing the following articles appearing in this issue has been defrayed by a generous grant from the Rockefeller Foundation for the publication of results of scientific work made to us through the kindness of the National Institute of Sciences, India :—

1. Vegetable Ghee (p. 94).
2. Sunspots (p. 95).
3. D.D.T. 666 and Insect Pests of Stored Grains (p. 98).
4. A Museum of Evolution (p. 99).
5. War and Indian Mineral Industry (p. 101).
6. Shellac Adhesives and Cements (p. 102).

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